

HSL No. 73-13

JULY 17, 1973

THIS ISSUE CONTAINS:

HS-012 732; HS-012 769-815; 817-843

HS-800 811

**U.S. Department of
Transportation**

**National Highway
Traffic Safety
Administration**



Shelve in Stacks

S. B. T.

Highway Safety Literature

... A SEMI-MONTHLY ABSTRACT JOURNAL

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A document containing several articles is announced as complete volume under an HS number referring to it as a whole. Entries for individual articles are listed under their own HS numbers.

SAMPLE ENTRIES

JOURNAL ENTRY

Title of Document

SYNTHESIS OF CASE LAW JURISPRUDENCE RELATING TO WET-WEATHER HIGHWAY CONDITIONS

Journal Citation

Highway Research Record n 376 p29-36 (1971)
D. C. Oliver 1971

Author(s)

Sponsored by Highway Res. Board Steering Com. for Workshop on Anti-Skid Program Management and presented at the workshop.

Search Terms

Descriptors: *Liability, *Negligence, *Accident responsibility, *Legal responsibility, *Wet road conditions, *Court decisions, *State government, *Skidding accidents, *Warning signs, *Highway maintenance, *Litigation, *Icy road conditions.

Abstract

The extant case law on legal liability for accidents occurring on icy and wet highways has established three central areas and one subarea in the jurisprudence of maintenance liability. These areas are compliance with general duties in order to escape liability; damages resulting from noncompliance (negligence); contributory negligence as a bar to recovery; and advisory signing as a technique in meeting general duties. Court decisions covering these four areas are presented.

NHTSA Accession Number

HS-012 289

*Subject heading in Subject Index

CONTRACT REPORT

EQUIPMENT AND PROCEDURES FOR MEASURING GLARE FOR MOTOR VEHICLES. FINAL REPORT

Corporate author

Teledyne Brown Engineering
N. E. Chatterton J. D. Hayes E. W. George 1972 102p
Contract DOT-HS-089-1-139

Availability

NTIS

Descriptors: *Glare, *Glare reduction, *Visual perception, *Photometers, *Luminance, *Hydraulic equipment, *Central vision, *Field of view, *Backgrounds, *Contrast, *Light conditions, *Brightness, *Test facilities, *Test equipment, *Vehicle safety standards, *Simulators, *Light, *Reflectance, *Measuring instruments.

A procedure and description of equipment for measuring glare from a driver's own vehicle are presented. The procedures are based on a disability glare theory as applied to foveal vision. Two pieces of apparatus were constructed to provide the measurement capability. One of them simulates diffuse sky glare and the other simulates direct solar glare. Methods of combining data from these measurements are presented along with scaling laws selected to provide a value for glare as it would be under natural daylight conditions. A standard for allowable glare levels from the vehicle is developed which is independent of the measurement procedure. Test results from a passenger car are presented and compared with this standard. Recommendations for improvements to the apparatus and additional research requirements for improvement to the theory are made.

HS-800 731

*Subject heading in Subject Index

1. ACCIDENTS

1B. Injuries

EINFLUSS DER KONSTRUKTION VON PERSONENKRAFTWAGEN AUF VERLETZUNG DER INSASSEN BEIM VERKEHRSUNFALL (INFLUENCE OF THE DESIGN OF PRIVATE CARS ON INJURY TO THE OCCUPANTS IN ROAD ACCIDENTS)

K. Langwieder Paper-3/4
Text in German.
See serial citation

*Accident analysis, *Injury research, *Injury prevention, *Injury statistics, *Damage severity, *Occupant vehicle interface, *Fatality rates, *Damage patterns, *Door latch failures, *Ejection caused injuries, *Windshield caused injuries, *Laminated glass, *Head injuries, *Restraint system effectiveness, *Occupant protection, *Safety device effectiveness, *Injuries by body area, *Injuries by seat occupation, *Injury causes, *Insurance claims, *Energy absorbing systems, *Impact velocity, *Energy absorbing instrument panels,

The type and severity of vehicle damage and occupant injuries in over 10,000 accidents were examined from insurance claim data. Of damage to vehicles, 61% was to the front and 14% to the rear. Door latch failures occurred in 7.4% of the accidents studied, causing occupant ejection with a fatality rate of 9.6% opposed to 1.15% for all other accidents. The windshield was damaged in 20% of the accidents. However, in none of the 500 vehicles with laminated windshields did the head penetrate the windshield. Three point seat belts and integral headrests provided greater protection than two point belts and added on headrests. Fascia padding reduced the frequency of knee injuries. Diagrams showing the frequency of injuries by body area; the effect of internal safety measures in reducing injuries; and the impact speed ranges for side, rear, and front end collisions are included.

HS-012 777

ACCIDENTS INVOLVING INJURY TO OCCUPANTS OF COMMERCIAL VEHICLES

For primary bibliographic entry see Fld. 1C.
HS-012 782

AIRBAG EFFECTIVENESS--A CASE FOR THE COMPULSORY USE OF SEAT BELTS

For primary bibliographic entry see Fld. 5N.
HS-012 783

1C. Investigation And Records

EINFLUSS DER KONSTRUKTION VON PERSONENKRAFTWAGEN AUF VERLETZUNG DER INSASSEN BEIM VERKEHRSUNFALL (INFLUENCE OF THE DESIGN OF PRIVATE CARS ON INJURY TO THE OCCUPANTS IN ROAD ACCIDENTS)

For primary bibliographic entry see Fld. 1B.
HS-012 777

ANALYSES MEDICALES ET TECHNIQUES DES COLLISIONS SUR AUTOROUTE BILAN DE DEUX

ANNEES D'INVESTIGATION (MEDICAL AND TECHNICAL ANALYSES OF MOTORWAY COLLISIONS: SURVEY OF TWO YEARS OF INVESTIGATION)

F. HartemannA. PatelC. TarriereC. Thomas Paper-3/5
Text in French.
See serial citation

*Accident investigation, *Accident analysis, *Occupant protection, *Impact tests, *Injury prevention, *Fatality prevention, *Impact forces, *Human body impact tolerances, *Deformation analysis, *Seat belt usage, *Injuries by seat occupation, *Instrument panel design, *Steering wheel design, *Accident prevention, *Seat belt effectiveness, *Accident types, *Injury prediction, *Seat backs, *Energy absorbing seats, *Ejection, *Roadside hazards, *Impact angle, *Front end collisions, *Rear end collisions,

Investigation of accidents involving injuries and fatalities was conducted to evaluate vehicle passenger protection, particularly the effectiveness of Peugeot-Renault seat belts, and to suggest improvements. The main vehicle impact areas, number of impacts, and deformation resulting from the main impact and the collision object are shown. Risk of death or injury is greatest in the front seats, with frontal impact and upon collision with a stationary object. Steering wheel and dashboard design improvements reduce front seat injuries. Impact violence was determined from a deformation index to evaluate human tolerances and behavior of vehicle parts which are important for occupant protection. Impact violence was measured in simulated accident tests on the same vehicle type, and results were compared with the survey data. An obstacle-free belt at the roadside, occupant ejection prevention, front seat backs which tilt backwards under rear impact, and seat belt usage would reduce accidents and injuries.

HS-012 778

ACCIDENTS INVOLVING INJURY TO OCCUPANTS OF COMMERCIAL VEHICLES

I. S. Jones Paper-3/9
See serial citation

*Commercial vehicles, *Accident analysis, *England, *Injuries by accident type, *Accidents by vehicle size, *Injuries by vehicle size, *Single vehicle accidents, *Vehicle vehicle collisions, *Rural accidents, *Urban accidents, *Vehicle weight, *Front end collisions, *Head on collisions, *Side impact collisions, *Rear end collisions, *Rollover accidents, *Injury rates, *Fatality rates,

Data on 634 commercial vehicle accidents in one English county between 1965-1968 are analyzed. Taken into account are the proportions of accidents in urban and rural areas and accidents by vehicle weight. Single vehicle accidents represented 52% and caused half of all injuries; vehicle vehicle accidents represented 42% overall and about 43% of all injuries. Front end collisions constituted about 53%, side impacts 15%, overturning 14%, and rear end 11%. For occupant injuries by impact type 54% occurred in front collisions, 20% in overturning, 11% in side impacts, 11% in other single vehicle accidents, and 4% in rear end impacts. Corresponding figures for fatal and serious injuries were 73% in frontal impacts, 10% in overturning, 13% in side impacts, 3% in other single vehicle accidents, and 1% in rear

Field 1—ACCIDENTS**Group 1C—Investigation And Records**

end impacts. Almost all overturning, about 95%, occurred in single vehicle accidents.
HS-012 782

AIRBAG EFFECTIVENESS--A CASE FOR THE COMPULSORY USE OF SEAT BELTS

For primary bibliographic entry see Fld. 5N.
HS-012 783

AERODYNAMIQUE ROUTIER (AERODYNAMICS ON THE ROAD)

For primary bibliographic entry see Fld. 2G.
HS-012 788

2. HIGHWAY SAFETY**2D. Design And Construction****AERODYNAMIQUE ROUTIER (AERODYNAMICS ON THE ROAD)**

For primary bibliographic entry see Fld. 2G.
HS-012 788

2G. Meteorological Conditions**AERODYNAMIQUE ROUTIER (AERODYNAMICS ON THE ROAD)**

L. RomaniC. Deutsch
Text in French.
See serial citation

*Aerodynamics, *Wind forces, *Windbreaks, *Loss of control caused accidents, *Wind, *Anemometers, *Wind tunnel tests, *Scale models, *Wind direction, *Vehicle stability, *Embankments, *France,

Statistical investigations show a correlation between loss of control accidents and those areas where strong winds prevailed on the dates of the accidents. A gust-detector consisting of a flat-plate and strain gauge anemometer was used to establish the aerodynamic black spots along the Paris-Lyons motorway on a five-point scale. Ninety-three black spots were detected and their locations found to correlate very closely with accident statistics. Scale model wind tunnel tests confirmed how the wind field is disturbed by embankments and indicated the importance of the embankment gradient. Tests also demonstrated that two windbreaks 2 m high and 34 m apart can shield the gap in between. Low-wall windbreaks are ineffective, since they deflect the lower flow from vehicles without acting upon the upper flow. Metal grid windbreaks, diverting the wind current horizontally in the direction of travel, and wire-netting windbreaks with plastic slats fitted at a 45 degree angle offer possible solutions.
HS-012 788

CONTRIBUTION OF ENVIRONMENTAL TESTING TO VEHICLE EQUIPMENT RELIABILITY

D. E. Powell Paper-6/7
See serial citation

*Vehicle performance, *Performance tests, *Commercial vehicles, *Environmental factors, *Reliability, *Vibration tests, *Test equipment, *Failures, *Drop tests, *Temperature endurance tests, *Flammability tests, *Corrosion tests, *Durability tests, *Field tests, *Laboratory tests, *Correlation analysis, *Contaminants, *Salt effects, *Reviews, *Accelerated tests,

The methods employed to establish the extent and severity of international environmental hazards are described and a survey of relevant literature is included. Reference is made to recording vehicle data for subsequent computer aided analysis. Environmental equipment installed in a proving laboratory to establish reliability of commercial vehicle injection and electrical equipment, and procedures for accelerated laboratory tests such as shock, vibration, and simulation of climatic hazards, are described. Their effectiveness in relation to field trial experience is discussed in detail.
HS-012 806

3. HUMAN FACTORS**3A. Alcohol****THE INFLUENCE OF ALCOHOL AND MARIJUANA ON A MANUAL TRACKING TASK**

Toronto Univ.
L. D. ReidM. K. F. IbrahimR. D. MillerR. W. Hansteen SAE-730092
Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Alcohol effects, *Marijuana, *Drug effects, *Driver performance, *Tracking, *Driving task analysis, *Mathematical models, *Drinking drivers, *Test volunteers, *Design of experiments, *Synergism, *Spectral analysis, *Driver skills, *Driver errors,

Two projects have been carried out to determine the usefulness of employing human operator describing functions in the study of the influence of alcohol and marijuana on subjects performing a visual-manual control task. Significant alterations in the linear operator models were observed and interpreted as changes in the time delay, neuromuscular system, and operator noise injection. The results provide the basis for a linear model capable of describing the dynamic response of human operators while under the influence of the two drugs.
HS-012 831

3B. Anthropomorphic Data**PERFORMANCE REQUIREMENTS AND CHARACTERISTICS OF MECHANICAL NECKS**

General Motors Corp.
H. J. MertzR. F. NeatheryC. C. Culver GMR-1282
Prepared for presentation at General Motors Research Symposium 2-3 Oct 1972.
Corporate author

*Human body simulation, *Anthropomorphic dummy design, *Head forms, *Neck, *Flexion, *Extension, *Performance characteristics, *Neck motion range, *Head motion range, *Head movement, *Acceleration response, *Dynamic tests,

July 17, 1973

OTHER SAFETY-RELATED AREAS—Field 4

Codes And Laws—Group 4A

*Biomechanics, *Performance tests, *Anthropomorphic dummies,

A short history of the development of mechanical necks for anthropomorphic dummies is given. Mechanical neck response envelopes recommended by Mertz and Patrick are reviewed, and modified performance requirements for mechanical necks based on their biomechanical data from volunteers and cadavers, but emphasizing loading corridors, are proposed. Autogenous and dynamic neck trajectories of a volunteer are presented, and the difficulties of establishing a trajectory performance requirement are discussed. Four commercial dummy neck configurations were tested and found to be incompatible with the performance requirements. Several experimental necks were also tested and only the GMR Polymeric Neck demonstrated the feasibility of satisfying the requirements. However, additional efforts are required to assure proper performance of this neck when used in conjunction with a total dummy structure under a wider range of test conditions.

HS-012 817

3D. Driver Behavior

ANALYSIS OF THE DYNAMICS OF THE DRIVER-CAR SYSTEM AS A CONTRIBUTION TO SAFETY

For primary bibliographic entry see Fld. 5D.

HS-012 789

AIRDRAULIC SEAT SYSTEM

Coach and Car Equipment Corp.

For primary bibliographic entry see Fld. 5D.

HS-012 820

HYDRA-FLEX SEAT: A NEW KIND OF RIDE FOR TRUCK DRIVERS

Seats, Inc.

For primary bibliographic entry see Fld. 5N.

HS-012 821

THE INFLUENCE OF ALCOHOL AND MARIJUANA ON A MANUAL TRACKING TASK

Toronto Univ.

For primary bibliographic entry see Fld. 3A.

HS-012 831

THE INFLUENCE OF ALCOHOL AND MARIJUANA ON A MANUAL TRACKING TASK

Toronto Univ.

For primary bibliographic entry see Fld. 3A.

HS-012 831

3G. Drugs Other Than Alcohol

THE INFLUENCE OF ALCOHOL AND MARIJUANA ON A MANUAL TRACKING TASK

Toronto Univ.

For primary bibliographic entry see Fld. 3A.

HS-012 831

3H. Environmental Effects

AN ANALYSIS OF NOISE CONDITIONS PRESENT IN COMMERCIAL AND MILITARY VEHICLES

Texas A and M Univ.

J. E. Elliott AD-747 685

Master's thesis.

NTIS

*Vehicle noise, *Military vehicles, *Commercial vehicles, *Sound intensity, *Noise tolerances, *Acoustic measurement, *Farm vehicles, *Construction vehicles, *Public transportation, *Ears, *Hearing, *Noise standards, *Noise exposure, *Driver performance, *Health standards, *Federal laws, *Reviews, *Noise control, *Speed,

Literature on noise effects on hearing and human performance and the legal aspects of noise was searched, and a noise survey was conducted to determine whether hazardous noise conditions exist within construction, farm, or military vehicles. A check was also made on the basic modes of public transportation: plane, railroad, bus, taxi, and private automobiles. Extreme noise conditions were found in much of the construction and farm equipment. The military design vehicles also showed some situations of extreme noise. The public transportation modes were generally free from any extreme noise conditions.

HS-012 815

4. OTHER SAFETY-RELATED AREAS

4A. Codes And Laws

ON THE DESTABILIZING EFFECT OF LIQUIDS IN VARIOUS VEHICLES, PT. 1

VL N3-4

H. F. Bauer

Presented at Conference International Sur la Mecanique de Vehicule (2nd), Paris, 6-9 Sep 1971.

See serial citation

*Fluid flow, *Hydrodynamics, *Equations of motion, *Tanks (containers), *Elastohydrodynamics, *Vehicle stability, *Resonant frequency, *Damping, *Oscillation, *Pitch, *Yaw, *Roll, *Displacement, *Kinetic energy, *Liquid membranes, *Geometric forms, *Mathematical representations, *Vibration, *Mechanics (physics), *Surface dynamics,

The unrestrained free surface of a liquid has a propensity to undergo large excursions for even very small motions of the container. This fact may endanger the stability as well as the riding and maneuvering quality of the vehicle. The response of liquids contained in cargo or fuel tanks is of some concern, especially in those cases where the sloshing liquid masses occupy a large amount of the total mass of the vehicle. The theory of liquid motion with a free surface is presented for containers of various geometries. Forces and moments of the liquid exerted upon the vehicle are presented and a simple mechanical model for representation of the liquid motion is derived. Methods for reducing the destabilizing effect of the liquid motion, such as baffles, cross walls, and surface coverings are presented. In addition the interaction of the liquid motion with the elastic structure of the container, as well as the interaction with a controlling system of the vehicle, is demonstrated.

HS-012 810

Group 4C—Cost Effectiveness

4C. Cost Effectiveness

THE AIR POLLUTION PROBLEM IN EUROPE. A PLEA FOR PRACTICAL SOLUTIONS

For primary bibliographic entry see Fld. 5F.
HS-012 769

VEHICLE WHOLE LIFE COST PREDICTION--A PURCHASE STRATEGY

H. C. Bradfield Paper-6/1
See serial citation

*Vehicle procurement, *Benefit cost analysis, *Fleet management, *Vehicle operating costs, *Repair costs, *Vehicle maintenance, *Life expectancy, *Service life, *Government vehicles, *Great Britain,

Cost effective vehicle fleet ownership depends on a clear definition of corporate objectives, an equipment policy, and a comprehensive definition of the vehicle to be purchased; a discriminating purchasing procedure; intensive operation and a realistic commercial policy; a rigorously applied planned cost effective maintenance adequately monitored to provide the basis for an economic vehicle replacement plan; careful selection, development, promotion, and replacement of human resources; and the discipline of cyclic review of achievements against targets at cost center level and above. The whole life cost prediction vehicle purchasing strategy utilized by Great Britain's Ministry of Defense is outlined and the whole life costs for a hypothetical fleet are calculated.

HS-012 800

VEHICLE FLEET PROVISION--THE OVERALL POLICY DECISION

B. Forsdick Paper-6/3
See serial citation

*Benefit cost analysis, *Mathematical models, *Service life, *Economic factors, *Vehicle operating costs, *Fleet management, *Value analysis,

A mathematical model of vehicle whole life costs is presented and is used to determine least cost lives when the costs of successive generations of vehicles are the same. The least cost life is the vehicle life that minimizes its average annual discounted cost of undertaking a given transport task. Methods of evaluation when the costs of successive generations of vehicles are not the same are also considered. The model may also be used to help determine the cost effectiveness of changes in operating conditions.

HS-012 802

AUTOMOBILE RELIABILITY--A KEY TO LOWER OVERALL TRANSPORT COSTS

For primary bibliographic entry see Fld. 5D.
HS-012 803

4D. Governmental Aspects

TOTAL ENERGY DEMAND FOR AUTOMOBILES

Oak Ridge National Lab.
E. Hirst R. Herendeen SAE-730065

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Energy consumption, *Gasoline consumption, *Oil consumption, *Conservation, *Vehicle operating costs, *Vehicle mileage, *Automobile occupancy, *Urban areas, *Rural areas, *Public transportation, *Travel costs, *Automobile manufacturing, *Automobile sales, *Automobile maintenance, *Automobile repair, *Gasoline refining, *Highway construction, *Insurance,

Automobiles in the United States consumed about 66 billion gallons of gasoline in 1970, with an energy content of 8900 trillion British thermal units (Btu). Two-thirds of this fuel was devoted to urban travel, the remaining one-third to intercity driving. This automobile gasoline consumption accounted for 54% of the total United States transportation energy budget. Direct consumption of gasoline by autos is only part of the automotive energy picture. Indirectly--to manufacture, sell, maintain, repair, insure, refine petroleum, and build highways for it--the automobile consumes about three-fifths as much energy as it does directly in gasoline, approximately 5500 trillion Btu in 1970. Including both direct and indirect energy, the auto consumed 16,000 Btu/vehicle-mile that year. This is equal to 21% of the total United States energy budget.

HS-012 833

4E. Information Technology

RANDOM VEHICLE VIBRATIONS AS EFFECTED BY DRY FRICTION IN WHEEL SUSPENSIONS

For primary bibliographic entry see Fld. 5R.
HS-012 812

4G. Mathematical Sciences

PREDICTING PERFORMANCE OF FUTURE CATALYTIC EXHAUST EMISSION CONTROL SYSTEMS

For primary bibliographic entry see Fld. 5F.
HS-012 771

AN APPROACH TO BRAKING SYSTEM RELIABILITY

For primary bibliographic entry see Fld. 5A.
HS-012 776

ROLE DE L'AGGRESSIVITE DES STRUCTURES EN COLLISION LATERALE (THE ROLE OF STRUCTURE AGGRESSIVENESS IN SIDE COLLISIONS)

For primary bibliographic entry see Fld. 5D.
HS-012 779

ON QUANTITATIVE EVALUATION OF SUBJECTIVE RIDE COMFORT

For primary bibliographic entry see Fld. 5D.
HS-012 784

July 17, 1973

OTHER SAFETY-RELATED AREAS—Field 4

Transportation Systems—Group 4H

HYBRID SIMULATION OF SHEAR FORCE DEVELOPMENT OF A TIRE EXPERIENCING LONGITUDINAL AND LATERAL SLIP

For primary bibliographic entry see Fld. 5V.
HS-012 785

A PROCEDURE FOR EVALUATING VEHICLE BRAKING PERFORMANCE

Michigan Univ. Hwy. Safety Res. Inst.
For primary bibliographic entry see Fld. 5A.
HS-012 786

ANALYSIS OF THE DYNAMICS OF THE DRIVER-CAR SYSTEM AS A CONTRIBUTION TO SAFETY

For primary bibliographic entry see Fld. 5D.
HS-012 789

THE HYBRID POWER PLANT: A COMPARISON WITH THE REGENERATIVE GAS TURBINE

For primary bibliographic entry see Fld. 5D.
HS-012 793

PROJECT FOR AN ELECTRIC CITY BUS WITH THERMAL REGENERATION

For primary bibliographic entry see Fld. 5O.
HS-012 796

MAINTENANCE AND REPAIR OF MILITARY VEHICLES

For primary bibliographic entry see Fld. 5K.
HS-012 808

ON THE DESTABILIZING EFFECT OF LIQUIDS IN VARIOUS VEHICLES, PT. 1

For primary bibliographic entry see Fld. 4A.
HS-012 810

A DYNAMICAL ANALYSIS OF A TOWED TWO-WHEEL TRAILER

For primary bibliographic entry see Fld. 5V.
HS-012 811

SOME OF THE PROBLEMS RELATED TO THE DESIGN OF PRIMITIVE LEVERED VEHICLES

For primary bibliographic entry see Fld. 5T.
HS-012 813

VEHICLE MOTION ANALYSIS IN RELATION TO VEHICLE SAFETY

For primary bibliographic entry see Fld. 5R.
HS-012 814

THE TRUCK STEERING SYSTEM FROM HAND WHEEL TO ROAD WHEEL

Ford Motor Co.
For primary bibliographic entry see Fld. 5R.
HS-012 830

CRASH DYNAMICS AND STRUCTURES OF THE EXPERIMENTAL SAFETY VEHICLE DEVELOPED BY GENERAL MOTORS

General Motors Corp.
For primary bibliographic entry see Fld. 5D.
HS-012 837

THE ENERGY MANAGEMENT STRUCTURE FOR THE VOLKSWAGEN ESV

Volkswagenwerk A.G. (West Germany)
For primary bibliographic entry see Fld. 5D.
HS-012 838

COMBUSTION CHAMBER GAS TEMPERATURES BY A BENZENE LIGHT-ABSORPTION TECHNIQUE

Shell Devel. Corp.
For primary bibliographic entry see Fld. 5F.
HS-012 841

A PRELIMINARY MODEL FOR THE FORMATION OF NITRIC OXIDE IN DIRECT INJECTION DIESEL ENGINES AND ITS APPLICATION IN PARAMETRIC STUDIES

Cummins Engine Co., Inc.
For primary bibliographic entry see Fld. 5F.
HS-012 842

THE EFFECTS OF LOW AMBIENT TEMPERATURES ON THE COMBUSTION OF NATURAL GAS IN A SINGLE-CYLINDER SPARK IGNITION ENGINE

Calgary Univ. (Canada)
For primary bibliographic entry see Fld. 5F.
HS-012 843

FEASIBILITY STUDY OF TRAILER TECHNIQUES FOR TIRE TRACTION, VOL. 1: SUMMARY. FINAL REPORT

Goodyear Tire and Rubber Co.
For primary bibliographic entry see Fld. 5V.
HS-800 811

4H. Transportation Systems

TOTAL ENERGY DEMAND FOR AUTOMOBILES

Oak Ridge National Lab.
For primary bibliographic entry see Fld. 4D.
HS-012 833

ENERGY EFFICIENCIES OF THE TRANSPORT SYSTEMS

Carnegie-Mellon Univ.
R. A. Rice SAE-730066
Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Fuel consumption, *Energy consumption, *Conservation, *Gasoline mileage, *Fuel economy, *Aerial transit systems, *Helicopters, *Automatic highways, *High speed ground transportation, *Automatic railroads, *Railroad passenger service, *Urban transportation, *Rural transportation, *Buses, *Electric

Automobiles, *Air cushion vehicles, *Vehicle performance, Forecasting, *Models,

The feasibility of holding oil consumption under the present 90 million gallons per year while transport output doubles in the next 25 years is explored. A model is developed in which 70% of cross-country travel is moved door-to-door in private vehicles, and over 50% of urban trips remain in private vehicles. If cross-country car-carriers are evolved and utilized, and if workable small electric vehicle systems are developed for urban use, it would not be necessary to use mandatory bus-type travel to cut energy ratios as the assumed requisite 50%. Alternative travel modes, such as tilt wing, short-runway takeoff-and-land aircraft, and high speed air cushion vehicles on tracked systems, are discussed but are not required or utilized in the model.

HS-012 834

1. VEHICLE SAFETY

1A. Brake Systems

AN APPROACH TO BRAKING SYSTEM RELIABILITY

Todorovic Paper-3/3
See serial citation

Brake systems, *Brake performance, *Brake tests, *Brake failures, *Reliability, *Mathematical analysis, *Service life, *Brake lining tests, *Brake lining wear, *Loads (forces), *Inertia dynamometers, *Wear tests,

A model of the reliability function for vehicle braking systems has been developed. Analysis is based on the recently formed theory of Reliability, which covers technical system failures. Recent investigations of brake lining reliability, resulting in the conclusion that the life of brake linings is subject to a Weibull distribution, are outlined, and research undertaken to determine actual brake lining loads and statistically significant criteria of brake lining loading per kilometer is reviewed. To obtain a fairly accurate and quick estimation of total reliability of brake linings, based on the known failure distribution and brake lining loads in various traffic conditions, the method of accelerated testing on a laboratory inertia dynamometer may be adopted.

HS-012 776

THE APPLICATION OF MINERAL-BASED HYDRAULIC FLUID IN THE AUTOMOBILE FIELD L'EMPLOI DU FLUIDE HYDRAULIQUE MINERAL DANS LE DOMAINE AUTOMOBILE)

Dalibert Paper-3/7
See serial citation

Hydraulic fluids, *Mineral oils, *Viscosity, *Lubrication, *Brake fluid tests, *Boiling points, *Vapor lock, *Pumps, *Corrosion prevention, *Corrosion tests, *Low temperature, *High temperature, *Polymers, *Water effect on brake fluids, *Seals, *Brake failures, *Sludge, *Hygroscopic properties, *Wear resistance,

Central hydraulic power systems require sufficient viscosity at high temperature to ensure proper hydraulic pump lubrication throughout fluid life. Hygroscopicity of conventional brake

fluids affects their boiling point and may cause brake failure (vapor lock). Vapor lock temperatures are recorded as a function of the water content of such fluids. Tests showed that 50% of cars have a vapor lock temperature below 143 degrees C. Mineral fluids eliminate vapor lock. Tests run on hydraulic rigs showed better lubrication, 90% wear reduction by weight, excellent corrosion protection, sludge formation reduction, and greater oxidation stability with mineral fluids. Lubrication and anti-corrosion properties reduce vehicle costs. No problems have arisen regarding mineral fluid compatibility with polymers, conventional fluids and their seals, or water. Perfect operability of mineral fluid has been demonstrated for six years in a central hydraulic system including brakes, steering, gear box control, and oleopneumatic suspension and for two years in a simple braking system.

HS-012 780

A PROCEDURE FOR EVALUATING VEHICLE BRAKING PERFORMANCE

Michigan Univ. Hwy. Safety Res. Inst.
R. W. Murphy Paper-3/13
Sponsored by Department of Transp.
See serial citation

*Brake performance, *Stopping distance, *Brake tests, *Performance tests, *Tire tests, *Tire performance, *Dry road conditions, *Wet road conditions, *Tire pavement interface, *Coefficient of friction, *Test equipment, *Tire loads, *Mathematical analysis, *Tire slip motion, *Speed, *Antilocking devices, *Asphalt pavements,

Two vehicles with disc brakes on the front and drum brakes on the rear wheels were tested on dry asphalt and on sealant-treated, wetted asphalt under three loading conditions to determine vehicle stopping distance. Each test was repeated ten times. Tire road interface tests were conducted with a mobile tire tester to establish peak tire road coefficients for the same speed and load conditions as in the vehicle tests. Tires showed little load or speed sensitivity on dry asphalt. Ideal stopping distances were calculated from peak coefficients for each load and surface condition and the braking system efficiency calculated from ideal and actual stopping distances. Test results showed a brake system efficiency of 60-70% on dry surfaces and 75-98% on low coefficient surfaces. The desired, vehicle braking performance can be determined by specifying limits on the brake system efficiency, tire factor, and wet-to-dry performance rating.

HS-012 786

ELECTRONIC ANTI-SKID SYSTEM--PERFORMANCE AND APPLICATION

P. MullerA. Czinczel Paper-3/14
See serial citation

*Antiskid devices, *Braking, *Skid control, *Performance characteristics, *Braking forces, *Lateral force, *Vehicle stability, *Vehicle control, *Sideslip, *Coefficient of friction, *Tire slip motion, *Stopping distance, *Performance tests, *Steering, *Vehicle dynamics,

Antiskid control systems increase traffic safety by reducing the stopping distance and maintaining vehicle stability and steerability during panic stops. The lateral and brake force coefficient

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cients together with the dynamic load of the individual wheels determine vehicle stability and brake behavior. An antiskid system controlling wheel speeds in an optimal range is capable of providing maximum vehicle deceleration, while ensuring sufficient lateral force. Three antiskid systems--front and rear axle control, select-low rear axle control, and individual front-wheel control with select-low rear axle control--are discussed. Their advantages and disadvantages as regards vital vehicle maneuvers are shown. The Teldix antiskid (individual four-wheel control) system and its operation are outlined, and its performance characteristics for braking in turns are illustrated. This system fulfilled performance requirements under all conditions.
HS-012 787

DUAL-USE FLUIDS FOR POWER STEERING AND POWER BRAKES

Dow Corning Corp.

For primary bibliographic entry see Fld. 5R.
HS-012 822

DEVELOPMENT OF THE BRAKE SYSTEM FOR THE GENERAL MOTORS EXPERIMENTAL SAFETY VEHICLE

General Motors Corp.

W. J. Oakley A. E. Roller W. J. Cattin SAE-730081

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Experimental automobiles, *Safety cars, *Brake system design, *Brake tests, *Brake standards, *Brake systems, *Parking brakes, *Double disc brakes, *Stopping distance, *Hydraulic brakes, *Power brakes, *Antilocking devices, *Pumps, *Weight sensing brake controls, *Warning signals, *Brake performance, *Caliper disc brakes,

Design of a four wheel, antilock disc brake system using a hydraulic power brake system with an electro-hydraulic back-up system, and the brake system components, including wheel lock control, a load sensing proportioner, and warning lights, are described. The design of the dual piston caliper for the disc brakes provides a redundant system thereby minimizing the effect of a single line or hose failure. Tests conducted during the development period indicate that the parking brake system is capable of holding on a 30% grade within the actuation limit of 90 lb maximum for a hand brake system and that braking efficiency and brake fade performance are very good.
HS-012 840

5B. Buses, School Buses, And Multipurpose Passenger Vehicles

DE LA DIMINUTION DE LA CONSISTANCE ET DE LA FREQUENCE DES OPERATIONS D'ENTRETIEN DES AUTOBUS REDUCING THE EXTENT AND FREQUENCY OF MAINTENANCE OPERATIONS ON BUSES)

For primary bibliographic entry see Fld. 5K.
HS-012 801

5D. Design

1974 VW ENERGY-ABSORBING BUMPER SYSTEM

Volkswagenwerk A.G. (West Germany)

U. Seiffert P. Kirschner SAE-730033

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Energy absorbing bumpers, *Bumper design, *Energy absorption, *Volkswagenwerk (West Germany), *Bumper height, *Bumper standards, *Hydraulic bumpers, *Foams, *Springs, *Pendulum tests, *Europe,

Theoretical requirements in bumper design are explained, with emphasis on bumper height, energy tolerance needs, energy absorption, and systems for absorbing the energy involved. The six energy absorbing bumper systems studied are assessed. The final design chosen for the 1974 Volkswagen is a bumper system comprised of two reinforced bumper profiles (one front and one rear) and four (two front, two rear) speed-sensitive dampers. This system is capable of complying with the requirements of FMVSS 215 that become effective Sept. 1, 1973. Bumper requirements as specified in Europe and the United States are compared.
HS-012 732

A NEW METHOD OF MEASURING TRANSIENT COMBUSTION GAS TEMPERATURES

J. Yamaga S. Shibata Paper-2/13

See serial citation

*Temperature, *Measuring instruments, *Combustion products, *Ultrasonics, *Acoustic measurement, *Frequencies, *Equations, *Oscillographs, *Gases,

When a rapid temperature change occurs uniformly in a gas, the frequency of sound waves passing through this gas also changes. Mathematical relationships between the sound wave frequency change and the temperature change of the combustion gases are derived and, by integrating these relationships, the equation relating frequency change to gas temperature is obtained. Using a four cycle gasoline engine equipped with sound vibrator and receiver, the frequency change was measured and using the derived equation the temperature change of the combustion gas was calculated. The sound vibrator and receiver are newly developed and designed compactly so that the fitting to the engine is easy. Using this equipment the continuous measurement of the combustion gas temperature in a reciprocating engine is possible.
HS-012 770

ROLE DE L'AGGRESSIVITE DES STRUCTURES EN COLLISION LATERALE (THE ROLE OF STRUCTURE AGGRESSIVENESS IN SIDE COLLISIONS)

J. Hamon Paper-3/6

Text in French.

See serial citation

*Vehicle vehicle interface, *Side impact collisions, *Mathematical models, *Structural design, *Side impact tests, *Rigid-

Group 5D—Design

ty, *Vehicle mass, *Body design, *Structural deformation analysis, *Experimental vehicles, *Crashworthiness,

The damage caused by an aggressor vehicle to another vehicle is proportional to the degree of protection it affords its own occupants as a result of the rigidity of its structure. A mathematical model for simultaneously analyzing the various parameters governing aggressiveness (rigidity, geometry of structure, and mass) was devised with the aim of gauging their relative importance and determining new structural design principles. Results obtained with the theoretical model showed a close correlation with side impact tests. The model was able to provide information on the locations and extent of structure deformation at the major design points; and it was also used as a basis for creating experimental vehicles especially designed for reduced front structure aggressiveness and for increased side protection. In side impact tests, the experimental vehicles showed considerably greater protection of the passenger compartment than possible with unmodified vehicles.

HS-012 779

ON QUANTITATIVE EVALUATION OF SUBJECTIVE RIDE COMFORT

T. TokudaM. Hiruka Paper-3/11

See serial citation

*Vehicle riding qualities, *Comfort, *Front suspension systems, *Automobile performance, *Automobile stability, *Acoustic measurement, *Vibration, *Road tests, *Vibration tests, *Regression analysis, *Vibration control, *Stiffness, *Tire uniformity, *Acceleration, *Tire forces, *Vehicle dynamics, *Crossply tires, *Radial tires, *Tire riding characteristics,

Recent tendencies in car design, such as reduction of weight, use of radial-ply tires, and stability at higher speeds, have had adverse effects on riding comfort. Quantitative evaluation methods for more restricted subjective comfort tests focusing on non-stationary vibration were developed. Harshness, a typical transient interdisciplinary phenomenon of noise and vibration, is analyzed by the statistical sensory test method. Physical quantities governing harshness are concentrated in vibrations from 20 to 60 Hz and sound from 60 to 120 Hz. Shake is closely related to tire nonuniformity or wheel rolling phase and the first harmonics of both lateral and fore-and-aft vibration are dominant. A dynamic measurement method for tire characteristics most significantly affecting harshness and shake was developed and its usefulness was confirmed. The vibration transmission mechanism is clarified. The effects of suspension are discussed. Experimental devices to test these components, especially tires are described.

HS-012 784

ANALYSIS OF THE DYNAMICS OF THE DRIVER-CAR SYSTEM AS A CONTRIBUTION TO SAFETY

L. Chidini Paper-3/16

See serial citation

*Vehicle dynamics, *Driver performance, *Mathematical models, *Driver behavior, *Driving task analysis, *Tracking, *Steering, *Road curves, *Driver reaction time, *Driver reaction distance, *Parameters, *Turning radius, *Lateral acceleration, *Axle loads, *Overtaking, *Oversteer, *Understeer, *Tire characteristics, *Moments of inertia,

Examination of the car-driver system response permits consideration of parameters affecting safety, particularly vehicle inertias, tire characteristics, and vehicle performance in general maneuvers. In an investigation with mathematical models for the driver and vehicle, the approach adopted was to achieve as total a rating as possible of driver response with comparatively few parameters. The basic maneuver dealt with is that of a steering correction on a constant-radius curve, including the transient inlet and outlet states. However, the method can be extended to cover any maneuver, and results for simulation of high-speed overtaking on a straight road are presented.

HS-012 789

DESIGN AND DEVELOPMENT OF A MULTI-CYLINDER MULTI-PURPOSE DIESEL ENGINE DESTINED FOR PRODUCTION IN LARGE VOLUME IN A SINGLE MANUFACTURING LOCATION

C. J. Hind Paper-4/1

See serial citation

*Engine design, *Diesel engines, *Cylinders, *Manufacturing, *Marketing, *Manufacturing standards, *Engine tests, *Production control, *Economic analysis, *Drive systems, *Marine engines, *Industrial engines, *Commercial vehicles,

The market for a given range of engines, varying technical requirements, and how they have been met and manufacturing problems have been minimized, are illustrated. The engines exemplified are the Perkins 6.354 six cylinder unit of 5.8 liters capacity and its four cylinder versions. To ensure that high volumes of production could be rapidly achieved and hence a satisfactory return on tooling cost, initial versions were designed for the commercial vehicle market. Continuing engineering development has enabled new requirements to be successfully met from the basic design.

HS-012 790

DEVELOPMENT OF A POWER PLANT PROGRAM FOR COMMERCIAL AND PUBLIC TRANSPORT VEHICLES

M. SerdaJ. Miralles de Imperial Paper-4/2

See serial citation

*Engine design, *Commercial vehicles, *Automotive engineering, *Manufacturing, *Engine size, *Horsepower, *Production lines, *Turbochargers, *Engine modification, *Economic factors, *Engine performance,

The feasibility of providing a complete range of engines between 95 and 450 hp for medium and large trucks, combined vehicles, buses, and articulated passenger transport vehicles from only two engine production lines is demonstrated. By the combination of aspirated and turbocharged solutions, small size power plants, four and six cylinder naturally aspirated and turbocharged engines and large power plants, six cylinder in-line naturally aspirated, turbocharged, and turbocharged intercooled engines, can be produced from two basic engines: a six cylinder in-line 6.5-7 liter engine and a six cylinder in-line 12-13 liter engine. This will permit an extensive engine range in those areas where the market conditions will not permit the manufacture of a greater number of basic model lines. Advantages of in-line engines for commercial vehicles are listed and features of turbocharged engines are discussed.

HS-012 791

PRELIMINARY INVESTIGATION ON A ROTARY COMPRESSION IGNITION ENGINE

D. P. HutchinsonD. MillarB. LawtonJ. E. C. Chandler Paper-4/4
See serial citation

*Rotary piston engines, *Engine design, *Engine tests, *Engine performance, *Dynamometers, *Test equipment, *Apex seals, *Experimental engines, *Power output, *Power loss, *Leakage, *Rotary expanders, *Compressors, *Air fuel ratio, *Combustion chamber design, *Friction, *Rolls Royce Motors Ltd.,

The R2, an experimental rotary compression ignition engine developed by Rolls-Royce Motors, Ltd., is described. Engine tests indicate that full speed, full load performance of the R2 engine is limited by two factors: the current stage of combustion chamber development which confines the engine to relatively high air fuel ratios; and high friction, as reflected in high coolant energy. Low speed performance is limited by two additional factors: leakage of trapped gas past the apex seals; and blow-back of gas from the high pressure unit as the transfer port closes. Static friction between an apex seal and rotor can jam the seal in its groove preventing efficient operation. Blow-back of gas from the high pressure unit is caused by a poor combination of compressor phase angle and transfer port position. The optimum compressor phase angle occurs when the scavange ratio is unity.

HS-012 792

THE HYBRID POWER PLANT: A COMPARISON WITH THE REGENERATIVE GAS TURBINE

M. Calovolo Paper-4/5
See serial citation

*Gas turbine engines, *Commercial vehicles, *Engine design, *Hybrid engines, *Regenerator design, *Engine performance, *Gas generators, *Engine size, *Power output, *Engine weight, *Costs, *Fuel consumption, *Engine operating conditions, *Operating temperature, *Thermodynamics, *Pressure, *Compression,

Part-load operation of regenerative gas turbines calls for low pressure ratio and high turbine inlet temperature in order to obtain maximum benefit from efficient regenerators. This entails high values of specific volumes throughout the hot section of the engine and across the regenerators, whose size is a dominating factor in establishing the arrangement and bulk size of the gas turbine. The hybrid powerplant, i.e., a high pressure engine where only the low pressure part of the cycle is handled by turbomachinery, leaving the high pressures and temperatures confined within a volumetric gas generator, appears to be a promising approach to the optimum engine for heavy industrial vehicles, both in terms of specific fuel consumption and reduced size for a given output. A comparison study is carried out, between hybrid vs. regenerative gas turbine powerplants, and application to a heavy truck is investigated.

HS-012 793

LUBRICANTS FOR FUTURE COMMERCIAL VEHICLE POWER PLANTS

J. Robson Paper-4/8
See serial citation

*Lubricating oils, *Lubricant additives, *Diesel engines, *Rotary piston engines, *Gas turbine engines, *Viscosity, *Mineral oils, *Multigrade oils, *Lubrication, *Commercial vehicles, *Forecasting,

Lubricant requirements for diesel, gasoline, rotary piston, and gas turbine engines are discussed. The majority of engines produced over the next two decades will be adequately lubricated by products formulated from conventional mineral oil bases, although synthetic materials may be used in limited applications where the technical requirement justifies their cost. Improved performance at higher bulk oil temperatures will be necessary together with better anti-wear behavior during longer oil change intervals. The deposits formed from lubricants used in future engines will be reduced.

HS-012 795

PROJECT FOR AN ELECTRIC CITY BUS WITH THERMAL REGENERATION

For primary bibliographic entry see Fld. 50.
HS-012 796

ONE MOTOR OIL TO MEET ALL EUROPEAN CAR MAKERS' REQUIREMENTS--DREAM OR REALITY?

G. LaneT. K. Longstrup Paper-5/3
See serial citation

*Multigrade oils, *Manufacturing standards, *European vehicles, *Standardization, *Engine tests, *Viscosity, *Engine wear, *Corrosion, *Corrosion tests, *Wear tests, *Wear resistance, *Ash content, *Corrosion inhibitors, *Lubricant additives, *Detergents, *Engine deposits, *Rustproofing, *Preignition, *Cold weather starting, *Engine operating conditions, *Oil pumps, *Valve lifters,

A single oil to meet all European car manufacturers' requirements is difficult to develop because of the variety of specifications and conflicts in requirements. A common service oil specification based on standardized test procedures could overcome these problems, but will require cooperation between the automotive and petroleum industries. Starting of European cars becomes sensitive to oil viscosity between -10 degree C and -25 degree C. In this area SAE 10W oils perform better than so called low viscosity SAE 20W oils. A conflict exists between manufacturers' antiwear requirements which could be overcome by extra oil additive treatment. Engine cleanliness and bearing corrosion limits are often specified via standardized tests. No conflicts in requirements exist in these areas. Antirust requirements of some manufacturers conflict with sulphated ash limits specified by others. Present specifications can be met with one oil but further improvements must await development of new additives or abandonment of one of the requirements.

HS-012 798

LUBRICANT REQUIREMENTS OF NEW POWER PLANTS FOR VEHICLES

B. J. MillerR. Hollinghurst Paper-5/4
See serial citation

*Lubrication, *Lubrication systems, *Wankel engines, *Gas turbine engines, *Steam engines, *Stirling engines, *Lubricant additives, *Operating temperatures, *Engine deposits, *Multigrade oils, *Mineral oils, *Performance tests, *Oil consumption,

Group 5D—Design

tion, *Thermal factors, *Apex seals, *Engine wear, *Preignition, *Viscosity, *Esters, *Thin films, *Forecasting, *Lubricants,

Lubricant requirements of gas turbine, Wankel, steam, and Stirling engines are discussed. Practical experience with the Wankel engine shows that lubricant selection can play a part in controlling seal wear and oil consumption, and in avoiding preignition. Some satisfactory experience with a selected 10W/30 multigrade oil is reported. The gas turbine engine generally requires synthetic lubricants due to high bearing soak back temperatures, but it appears that any lubrication problem with such units should be readily overcome. Excellent gas turbine performance is reported for a new generation oil derived from latest aviation oil technology. Synthesised hydrocarbon oils are attractive for future designs operating at slightly lower temperatures. Steam engine and Stirling engine lubrication needs are still the subject of some conjecture. It appears that synthetic lubricants, due to high viscosity index, lack of shear loss, and better thin film deposit formation tendencies on expander surfaces would be more efficient than mineral oils in the steam and Stirling engines.

HS-012 799

AUTOMOBILE RELIABILITY--A KEY TO LOWER OVERALL TRANSPORT COSTS

F. H. ZaludJ. Lanc Paper-6/4
See serial citation

*Benefit cost analysis, *Vehicle operating costs, *Service life, *Reliability, *Vehicle mileage, *Performance tests, *Vehicle performance, *Failures, *Time factors, *Repair costs, *Maintenance costs, *Vehicle maintenance, *Repairing, *Economic analysis, *Fleet management, *Transportation system costs, *Buses,

The effect of improved automobile reliability on the reduction of transport costs with simultaneous changes in vehicle price has been calculated. Lack of information on reliability in service prevents more detailed economic analysis. Experiences in establishing reliability information systems have been described. A proposal has been made to include the main reliability characteristics of automobiles in vehicle specifications. Such data should enable the fleet owner to plan maintenance and repair schedules and choose appropriate equipment for his purpose.

HS-012 803

CONTRIBUTION OF ENVIRONMENTAL TESTING TO VEHICLE EQUIPMENT RELIABILITY

For primary bibliographic entry see Fld. 2G.
HS-012 806

TURBOCHARGERS: ARE THEY ON THE WAY?

V148 N5
H. M. Nelson
See serial citation

*Turbochargers, *Engine design, *Horsepower, *Engine modification, *Exhaust emission control devices, *Fuel economy, *Engine tests, *Exhaust emission tests, *Exhaust emission measurement, *Engine performance, *Automobile power, *Turbocharging, *Automobile models, *Compression ratio, *Nitrogen oxides, *Carbon monoxide, *Hydrocarbons, *Engine size, *Coldstarts,

Engines must be redesigned to create space for installation of turbochargers. Development and methods of turbocharging are described. Turbocharging does not reduce mileage, and use of a smaller turbocharged engine may increase fuel economy. Tests on turbocharged automobile engines indicate reduction in hydrocarbons and nitrogen oxides. Carbon monoxide on cold-starts is a problem with turbochargers, and stalling or pumping the accelerator increases hydrocarbon and carbon monoxide emissions. Gasoline engines are limited in the amount of boost they can tolerate, and boost control systems are outlined. Because automobile engines do not often run at full power, turbocharger cost is more important than performance. Cost may be reduced by decreasing wheel burst speeds, greater use of die casting or stamped steel parts, and using a small engine for compacts and subcompacts, a 300 cubic inch (4917 cc) V-8 for the midrange engine and then turbocharging it for luxury cars.

HS-012 809

SOME OF THE PROBLEMS RELATED TO THE DESIGN OF PRIMITIVE LEVERED VEHICLES

For primary bibliographic entry see Fld. 5T.
HS-012 813

POWER/WEIGHT RATIO FOR TRACTOR TRAILERS

Associated Truck Lines, Inc.
For primary bibliographic entry see Fld. 5T.
HS-012 819

AIRDRAULIC SEAT SYSTEM

Coach and Car Equipment Corp.
A. Harder SAE-720915
Presented at National Commercial Vehicle Engineering and Operations Meeting, Fort Wayne, 9-12 Oct 1972.
SAE

*Seat design, *Air suspension systems, *Gas dynamics, *Seat positioning, *Hydraulic equipment, *Vibration response, *Vibration control, *Damping, *Human factors engineering, *Seat tests, *Servomechanisms, *Resonant frequency, *Driver vehicle interface, *Comfort, *Inflatable seats,

The airdraulic seat system is an air-oil cushioning system to which has been added a servo-linkage to operate a two port hydraulic valve. Features of the system contributing to a comfortable ride for the operator include limitation of rebound; unlimited vertical adjustment of seat position; automatic compensation for operator's weight; clearance between front of seat cushion and steering wheel rim when operator dismounts; and natural frequency of 1 cycle per second.

HS-012 820

OSHKOSH POWERMATIC TRANSMISSIONS FOR ON/OFF-HIGHWAY VEHICLES 04W. K. Blank

Oshkosh Truck Corp.
SAE-720908
Presented at National Commercial Vehicle Engineering and Operations Meeting, Fort Wayne, 9-12 Oct 1972.
SAE

*Transmission design, *Transmissions, *construction vehicles, *Off the road vehicles, *Engine speeds, *Torque, *Gear speeds, *Vehicle maintenance, *Clutches, *Bearings, *Spur gears, *Drive systems, *Shafts, *Oil pumps, *Transmission tests, *Simulation, *Performance tests, *Road tests, *Emergen-

July 17, 1973

VEHICLE SAFETY—Field 5

Design—Group 5D

cy vehicles, *Snow plows, *Vehicle performance, *Stress (mechanics), *Shift lever sequence,

The Oshkosh transmission design consists of a two-speed splitter auxiliary attached to the four-speed main drop box to provide a transmission with eight forward and two reverse speeds. Omitting the auxiliary provides a transmission with four forward speeds and one reverse speed. The eight-speed transmission is capable of use with high speed, low torque engines, or with low speed, high torque engines by changing the input ratio gears. The overall ratio of the transmissions may be changed to match tire size and/or axle ratios. The ratio changes for engine speed-torque and/or overall ratio may be made without affecting the transmission range or physical configurations. Bearing, gear, clutch pack, all wheel drive, shafts, and oil supply design, and cooling requirements and component selection are discussed. Simulation and road tests were performed, and application of powermatic transmissions to construction, rescue, and snow removal vehicles is described.

HS-012 824

MACK POWER DIVIDER

Mack Trucks, Inc.
R. W. Stieg SAE-720906
Presented at National Commercial Vehicle Engineering and Operations Meeting, Fort Wayne, 9-12 Oct 1972.
SAE

*Interaxle differentials, *Differential design, *Cams, *Differentials, *Torque, *Equations, *Lubrication, *Lubricant additives, *Manufacturing, *Drawbar pull,

The history, theory, operation, and refinements of one of the oldest limited-slip vehicle axle and tandem interaxle differentials that has remained in continuous production are discussed. The design uses a cam and wedge principle, but is a true differential in the manner of a conventional geared unit. Its unique drive principle provides frictional bias in a ratio between 2-3:1 to increase vehicle drawbar pull on split-coefficient surfaces.

HS-012 825

A SHIFTABLE CONTROLLED TRACTION DIFFERENTIAL FOR HEAVY-DUTY TRUCKS

Eaton Corp.
W. W. Hoenes SAE-720905
Presented at National Commercial Vehicle Engineering and Operations Meeting, Fort Wayne, 9-12 Oct 1972.
SAE

*Controlled slip differentials, *Differential design, *Lubrication systems, *Torque, *Traction, *Clutch plates, *Truck design, *Performance characteristics, *Heavy duty vehicles,

A shiftable controlled traction differential developed for both on and off highway heavy duty trucks is described. The differential can provide greater limited slip action when engaged for adverse driving conditions than current designs and yet not have the undesirable aspects normally associated with limited slip differentials. A unique lubrication system incorporated in the differential, that extends the life of the unit, is also described.

HS-012 826

NOSPIN AND TANDEM-LOCK DIFFERENTIALS--OPERATION AND APPLICATION

Detroit Automotive Products Corp.
A. A. Choma SAE-720904
Presented at National Commercial Vehicle Engineering and Operations Meeting, Fort Wayne, 9-12 Oct 1972.
SAE

*Selflocking differentials, *Differential design, *Wheel spinning, *Spin control, *Transmission design, *Vehicle performance, *Drive systems, *Torque, *Cornering, *Clutches, *Cams, *Disc clutch teeth, *Wheel locking, *Commercial vehicles, *Axles, *Axle loads, *Traction, *Frames, *Off the road vehicles,

The operation and design of three types of NoSPIN differentials--the standard type with individual cam indexing, the silent type with holdout ring index control, and the silent-over-running with directional holdout ring index control--and two types of Tandem-Lock differentials--conventional NoSPIN and inside-out design--are described. Guidelines for application of NoSPIN differentials to straight and articulated frame commercial vehicles are presented. The Tandem-Lock differential improves vehicles mobility as compared to locking either forward rear or rear-rear axle. Use of additional NoSPINs (in addition to Tandem-Lock) is recommended when off-road use is encountered or unusually marginal surface road traction conditions are prevalent.

HS-012 827

RESTRICTIVE DIFFERENTIALS

North American Rockwell Corp.
S. E. Chocholek R. C. Ferbitz SAE-720903
Presented at National Commercial Vehicle Engineering and Operations Meeting, Fort Wayne, 9-12 Oct 1972.
SAE

*Differentials, *Differential design, *Performance characteristics, *Traction, *Torque, *Coefficient of friction, *Tire pavement interface, *Road conditions, *Vehicle handling, *Wheel spinning, *Trucks,

Various methods have been used to restrict differential action in drive axles to prevent loss of traction. Based on tractive effort performance, most devices can be categorized into one of four basic classifications. Class 1 includes the standard bevel gear differential, and certain types of devices which depend on inefficiency, such as worm gearing. Variations of the friction clutch differential are included in Class 2. Devices which have the potential of providing total tractive effort through one axle shaft are representative of Class 3, and Class 4 includes differentials which exhibit some built-in torque and mechanisms which reduce the effectiveness of the unit as tractive conditions improve. Differentials from all four classes were compared to the requirements needed for an ideal differential. It was concluded that a device does not exist that will provide the required torque distribution between two or more driven members under all conditions of relative motion as dictated by ground speed and still limit the torque to one member to avoid wheel spinning.

HS-012 828

4 X 4 HIGHWAY TRACTOR CONCEPTS

Eaton Corp.

Field 5—VEHICLE SAFETY

HSL 73, No. 13

Group 5D—Design

J. Mueller SAE-720901

Presented at National Commercial Vehicle Engineering and Operations Meeting, Fort Wayne, 9-12 Oct 1972.
SAE

*Drivetrains, *Tractor trailers, *Four wheel drives, *Drive axles, *Front axles, *Rear axles, *Axle loads, *Clutches, *Traction, *Torque, *Weight transfer, *Differentials, *Drivelines, *King pins, *Joints, *Durability tests,

Two new 4 x 4 drivetrain systems developed for highway tractors that are used to pull multiple trailer combinations, are described. The first one is a 4 x 2 that automatically becomes a 4 x 4 when conditions exist that require 4 x 4 operation. The second one is a full time 4 x 4 that proportions the drive torque 36% to the front axle and 64% to the rear axle. A unique front driving steering axle has also been developed that permits a 4 x 4 system to be installed in a standard 4 x 2 truck. There is no need to relocate any major components to make space available for a front driving steering axle.

HS-012 829

INTERNATIONAL EFFORTS TO CONTROL RADIO SPECTRUM POLLUTION FROM MOTOR VEHICLES

Ford Motor Co.

F. Bauer SAE-730058

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Radio interference, *Electromagnetic radiation, *Electromagnetic radiation measurement, *Ignition systems, *International factors, *Standards, *Intergovernmental relations, *Radiation effects, *Frequencies, *Electric properties,

International cooperation in radio interference control has recently accelerated and broadened in scope. The U. S. automotive industry is affected principally by international legislative restrictions on spurious radiations of radio energy from internal combustion engines. By virtue of its participation in international negotiations, the U. S. has made contributions to the international standard (CISPR Recommendation 18/2), has furthered uniform requirements, and has strengthened its own standard (SAE J551a). The organization and functions of the Comite International Special des Perturbations Radioelectriques (CISPR) or the International Special Committee on Radio Interference are described. U. S. participation in CISPR and the status of various radio interference projects are discussed. The SAE standard (SAE J551a) on measurement of electromagnetic radiation from vehicles and the CISPR recommendation (18/2) on interference from ignition systems are included.

HS-012 832

ENERGY EFFICIENCIES OF THE TRANSPORT SYSTEMS

Carnegie-Mellon Univ.

For primary bibliographic entry see Fld. 4H.

HS-012 834

FORD ESV ENERGY MANAGEMENT SYSTEM

Ford Motor Co.

K. H. ArningJ. R. FeustelA. Rhodes SAE-730074

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

*Experimental automobiles, *Safety cars, *Automobile design, *Crashworthy bodies, *Energy absorbing frames, *Energy absorbing front structures, *Fenders, *Hydraulic bumpers, *Crush distance, *Energy absorption, *Crush tests, *Barrier collision tests, *Deceleration, *Impact forces,

The Ford experimental safety vehicle (ESV) incorporates a unique body/frame energy absorbing system designed to dissipate the kinetic energy of a 50 mph barrier crash. The basic system elements are a crushable frame, a controlled collapse fender apron, and hydraulic bumper struts. During the impact 65% of the energy is dissipated in the frame and the remaining 35% in the body structure producing progressively higher passenger compartment decelerations. Barrier collision tests at 50 mph show the ESV structure to be superior to the production vehicle in meeting objectives of minimum passenger compartment intrusion with compartment decelerations of approximately 40 g's. The Ford ESV concept was to attempt to meet government objectives by upgrading a production vehicle, using designs and materials suitable for mass production processes. However, the final design required components highly experimental in nature, having substantial increases in weight and cost over the production Ford.

HS-012 835

SMALL VEHICLE STRUCTURAL DESIGN

Fiat S.p.A. (Italy)

G. Puleo SAE-730075

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

*Automobile design, *Automobile dimensions, *Automobile bodies, *Unitized body construction, *Body design, *Safety design, *Experimental automobiles, *Passenger compartments, *Vehicle weight, *Crashworthiness, *Structural design, *Barrier collision tests, *Head on impact tests, *Impact velocity, *Pole impact tests, *Rear end impact tests, *Body tests, *Rollover tests, *Drop tests, *Pillars, *Side impact tests, *Energy absorbing systems, *Safety cars, *Compact automobiles,

General structural design criteria and the structural characteristics of a 1200 lb class standard car and a 1500 lb experimental safety vehicle (ESV) were studied. Crashworthiness of the 1200 lb car was evaluated by barrier collision tests conducted at increasing speeds and by rollover drop tests. Test results, which indicate that a weight increase of at least 30% is necessary to meet survival space requirements, led to the development and testing of the 1500 lb ESV. Considering the negative consequences that such a weight increase would have on the technical, economic, and commercial characteristics of small cars, it is doubtful that such a solution will be acceptable in practice. To solve present structural problems a compromise must be reached between safety requirements and those which condition the existence of the small car.

HS-012 836

CRASH DYNAMICS AND STRUCTURES OF THE EXPERIMENTAL SAFETY VEHICLE DEVELOPED BY GENERAL MOTORS

General Motors Corp.

F. J. BakewiczR. ChupickR. G. FischerR. E. Roland SAE-730076

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

*Experimental automobiles, *Safety cars, *Structural analysis, *Barrier collision tests, *Crashworthiness, *Automobile bodies, *Body design, *Energy absorbing front structures, *Bumper design, *Underbodies, *Instrument panel design, *Roof supports, *Roofs, *Rear compartments, *Door systems, *Frame design, *Angle impact tests, *Rear end impact tests, *High speed impact tests, *Impact velocity, *Computerized simulation, *Deformation analysis, *Impact angle, *Occupant protection, *Vehicle dynamics, *Occupant kinematics, *Dummies,

Structural analysis and design requirements for crashworthy experimental automobile body components, including energy absorbing bumpers and front ends, underbodies, instrument panels, center pillars, credenza beams, roof and rear seat back cross body structures, rear quarter panels, rear luggage compartments, door systems, and frames are presented in an attempt to relate structural characteristics to dummy occupant kinematics. Barrier impact results are simulated and compared with results of a 50 mph front barrier test, a 50 mph rear moving barrier test, and a 30 mph front 45 degree barrier test. Test results are presented graphically and simulated and actual deformation results are tabulated.

HS-012 837

THE ENERGY MANAGEMENT STRUCTURE FOR THE VOLKSWAGEN ESV

Volkswagenwerk A.G. (West Germany)

H. Appel J. Tomas SAE-730078

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.

SAE

*Shock absorbers, *Hydraulic equipment, *Energy absorption, *Experimental automobiles, *Safety cars, *Volkswagens, *Vehicle vehicle interface, *Vehicle weight, *Crashworthiness, *Impact forces, *Impact velocity, *Mathematical models, *Equations of motion, *Displacement, *Deformation, *Deceleration, *Vehicle vehicle impact tests, *Head on impact tests, *Side impact tests, *Safety device costs, *Automobile conversion costs,

In order to improve vehicle crashworthiness, attention must be given both to an improvement of the occupant crash protection and to a reduction in the aggressiveness of heavy vehicles toward lighter vehicles. By use of hydraulic shock absorbers in the bumper system, an energy-absorption distribution can be achieved in vehicle vehicle collisions without requiring larger deformations on the large vehicle than on the smaller vehicle. A theoretical investigation was conducted concerning which type of hydraulic absorbers can best achieve the ideal weight dependent layout of the frontal structure. A hydraulic absorber with a stroke controlled throttle outlet area appears to be a suitable type. With this system, energy distribution in frontal impacts is attained and most of the energy is absorbed in the frontal structure of the impacting vehicle in rear and side collisions. The proposal for energy distribution and absorption achieved by weight and velocity dependent frontal crash behavior was tested and confirmed by impact tests.

HS-012 838

HANDLING CHARACTERISTICS OF THE GENERAL MOTORS EXPERIMENTAL SAFETY VEHICLE

General Motors Corp.

For primary bibliographic entry see Fld. 5R.

HS-012 839

5F. Fuel Systems

THE AIR POLLUTION PROBLEM IN EUROPE. A PLEA FOR PRACTICAL SOLUTIONS

M. A. I. Jacobson Paper-2/12

See serial citation

*Exhaust emission standards, *Exhaust emission control, *Benefit cost analysis, *Europe, *Ignition timing, *Vehicle maintenance, *Fuel additives, *Leaded gasoline, *Vehicle inspection, *Exhaust emission tests, *Manufacturing standards, *Inspection equipment, *Exhaust emissions, *Air pollution control costs, *Consumer acceptance,

The need for stringent regulations along U.S. Federal lines does not exist in Europe. It is proposed that one separate standard for all of Europe be adopted based on Economic Commission for Europe proposals. The following action is suggested: mandatory fitting of long-life exhaust systems, manufacture and fitting of more closely calibrated carburetors which will remain accurately set for a 3-5 year period, introduction of multi-spark electronic ignition to improve combustion, particularly of lean mixtures of stratified charges, improvements in combustion chamber and valve gear detail design, fitting of active carbon filter and sealed filler cap into gas tank assembly to reduce smell and hydrocarbon emission, lowering the lead content of gasoline by 20-40% and making the inclusion of a small amount of detergent additives compulsory. Costs of air pollution control, effectiveness of vehicle maintenance, and extension of compulsory vehicle emissions testing are discussed.

HS-012 769

PREDICTING PERFORMANCE OF FUTURE CATALYTIC EXHAUST EMISSION CONTROL SYSTEMS

J. C. W. Kuo C. D. Prater D. P. Osterhout P. W. Snyder J. Wei

Paper-2/14

See serial citation

*Afterburners, *Mathematical models, *Catalytic converters, *Exhaust emission control, *Forecasting, *Exhaust emission standards, *Exhaust emission control device tests, *Engine modification, *Performance tests, *Exhaust emission measurement, *Temperature, *Catalyst tests, *Carbon monoxide, *Hydrocarbons, *Nitrogen oxides, *Calibration,

Predictive catalytic converter mathematical models were constructed for both particle or monolithic support catalysts using either noble or base metal as active ingredients. The models have been used as a research and development tool for improving total emission control systems, including catalyst development, engine calibration modification, converter location, and converter design studies. The strategy in application of the models is to maintain a continuous dialogue between test results and the mathematical model predictions of a total vehicle-converter system that can meet stated goals. Examples of use of the models to identify catalyst and engine modification required to meet U. S. 1976 emission standards and to focus on specific vehicle developments and assist in the interpretation of emission control system test data are described.

HS-012 771

Group 5F—Fuel Systems

MECHANICAL MODIFICATIONS FOR EMISSION CONTROL UNDER EUROPEAN CONDITIONS

M. CamarsaB. J. KrausG. Marcenaro Paper-2/15
See serial citation

*Exhaust emission control, *Exhaust gas recirculation, *Carburetor design, *Engine modification, *Exhaust system design, *Exhaust emission tests, *Driveability, *Lean fuel mixtures, *Air fuel ratio, *Nitric oxide, *Hydrocarbons, *Carbon monoxide, *Oxidation, *Exhaust manifolds, *Power loss, *Fuel consumption, *Spark timing, *European vehicles,

An investigation was carried out on a medium sized European vehicle to determine the technical capabilities for controlling carbon monoxide, hydrocarbons, and nitric oxide emissions by intake and exhaust modifications and exhaust gas recirculation. Intake modifications were limited to the carburetor for permitting lean operation with acceptable driveability. The exhaust system was modified to increase residence time and temperature for improved secondary oxidation. Though the results show little hope for application of this approach to meet the future U. S. emission requirements, substantial improvements were achieved over the present requirements in Europe. A reduction in power was noticed due to this technique but no practical penalty was experienced in driveability and fuel consumption. The very favorable cost effectiveness ratio of this approach, compared to others, should be a point of consideration in deciding on the possible future limits to set in Europe.
HS-012 772

DETERMINATION OF AUTOMOTIVE EMISSION STANDARDS FROM AIR QUALITY STANDARDS

W. H. Brehob Paper-2/16
See serial citation

*Emission standards, *Air quality standards, *Emission control, *Mathematical models, *Vehicle air pollution, *Mathematical analysis, *Ambient air quality, *Environmental factors, *Carbon monoxide, *Hydrocarbons, *Nitrogen oxides,

Two general methods of calculating the emission standards required to achieve a specified air quality standard are available—modeling and rollback. Modeling is theoretically of broader application and more accurate, but the large amount of input data required and lack of basic information on mechanisms preclude its general use. Therefore, the rollback technique is used in spite of its limitations. Attention is drawn to these limitations by working actual numerical examples. Two sets of assumed input data for the U. S., most conservative and reasonable, are used in the calculations to show the sensitivity of the rollback calculation to input data. The input data required are air quality standards, present air quality, background, growth factor, and the relation between hydrocarbon and oxidant. Methods of emission regulation and means of implementing them are considered. Maximization of cost effectiveness is recommended as the main criteria in choosing between alternate implementation schemes.
HS-012 773

COMPARATIVE STUDY OF METHODS OF REDUCING EXHAUST EMISSIONS TO VERY LOW LEVELS

C. D. HaynesR. Lindsay Paper-2/17

See serial citation

*Exhaust emission standards, *Engine modification, *Exhaust gas recirculation, *Oxidation catalysts, *Exhaust emissions, *Thermal reactors, *Oxidation, *Air fuel ratio, *Rich fuel mixtures, *Lean fuel mixtures, *Ignition timing, *Combustion chamber design, *Fuel consumption, *Dual bed catalyst systems, *Exhaust emission control, *Engine operating conditions, *Catalytic converters,

Two approaches for exhaust emission limitation are possible: the preventive method, by which engine operating conditions are modified to reduce pollutant-forming tendencies in the engine, and the curative method, by which emissions are treated after their formation and rendered harmless. In practice, combinations of the two methods are necessary to meet 1976 U. S. standards. Methods of controlling emissions combining both the preventive and curative, are outlined, including: exhaust gas recirculation (EGR) with either thermal or catalytic oxidation, a lean fuel ratio with EGR and thermal reactor, an ultra-rich air fuel ratio/thermal (catalytic) oxidation, dual and single catalysts, an ultra-lean air fuel ratio/catalytic hydrocarbon oxidation, or a nitric oxide reduction catalyst with thermal reactor.
HS-012 774

MOTOR GASOLINES IN THE SEVENTIES

D. BarkerD. Ellis Paper-5/2
See serial citation

*Gasoline quality, *Fuel composition, *Antiknock ratings, *Knock, *Octane requirements, *Lead alkyls, *Olefins, *Octane ratings, *Lead free gasoline, *Exhaust valve wear, *Leaded gasoline, *Forecasting,

During the coming decade significant changes will take place in both vehicle operation and vehicle legislation, which will affect gasoline quality and engine design. As motorway mileage increases, the opportunity for sustained high speed vehicle operation also increases. The presence of olefinic components in gasoline can increase the possibility of spark knock occurring at high engine speeds. However, olefinic components are particularly useful for manufacturing gasolines of acceptable antiknock performance under low speed conditions and their usefulness will increase as gasoline lead levels decrease. From the legislation viewpoint, the most significant change in gasoline quality anticipated in the next 10 years is the partial or complete elimination of lead alkyl antiknock additives. The effect of gasoline/engine relationships such as octane requirements increases and valve seat recession are discussed.
HS-012 797

COMBUSTION CHAMBER GAS TEMPERATURES BY A BENZENE LIGHT-ABSORPTION TECHNIQUE

Shell Devel. Corp.
W. W. HaskellD. K. TrumpyC. H. Hendrickson SAE-730082
Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Combustion chambers, *Fuel mixture temperature, *Thermometers, *Benzene, *Butadienes, *Absorption, *Ultraviolet radiation, *Calibration, *Flowmeters, *Data acquisition, *Data analysis, *Parameters, *Engine operating conditions, *Compression, *Pressure, *Transducers, *Density, *Heat transfer, *Internal combustion engines, *Cyclohexane,

July 17, 1973

VEHICLE SAFETY—Field 5

Maintenance And Repairs—Group 5K

A method for measuring mixture temperatures in internal combustion engines during the compression process up to the time of knock, based on the light-absorbing properties of benzene vapor, is described. The ultraviolet light absorption coefficient of benzene vapor has been measured over a temperature range of 300-1400 K (80-2060 F). This absorption coefficient, which is very sensitive to temperature, is a function of temperature to the eighth power at room temperatures and decreases smoothly to a fourth power function at approximately 1000 K (1340 F). The extreme sensitivity of the absorption coefficient to temperature allows precise determination of gas temperatures during the early part of the compression process in a Cooperative Fuel Research engine and throughout compression of the fuel/air mixture. The data quantitatively support an analytical prediction that heat transfer from the chamber wall to the inlet mixture, during the intake stroke, causes increased compression temperature histories.

HS-012 841

A PRELIMINARY MODEL FOR THE FORMATION OF NITRIC OXIDE IN DIRECT INJECTION DIESEL ENGINES AND ITS APPLICATION IN PARAMETRIC STUDIES

Cummins Engine Co., Inc.

S. M. Shahed W. S. Chiu V. S. Yumlu SAE-730083

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Nitric oxide, *Mathematical models, *Diesel engine exhaust emissions, *Combustion, *Gas formation, *Thermodynamics, *Fuel injection, *Temperature, *Cylinder pressure, *Computerized simulation, *Combustion rate, *Exhaust emission tests, *Cetane number, *Engine tests, *Injection timing, *Exhaust gas recirculation,

A semiempirical, mathematical model describing the formation of nitric oxide in direct-injection diesel engines is derived. The model is used in conjunction with injection and thermodynamic cycle simulation programs. This approach enables prediction of nitric oxide emissions from design dimensions and operating parameters only, without the use of experimental data. Predicted results are compared with experiments for typical naturally aspirated and turbocharged engines. The accuracy of prediction is very good except under light-load naturally aspirated conditions. The model is used in an extensive parametric study, together with experimental verification. The agreement between prediction and experiments is excellent, except under conditions of excessive smoke or of high swirl.

HS-012 842

THE EFFECTS OF LOW AMBIENT TEMPERATURES ON THE COMBUSTION OF NATURAL GAS IN A SINGLE-CYLINDER SPARK IGNITION ENGINE

Calgary Univ. (Canada)

G. A. Karim I. A. Ali SAE-730084

Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Ambient temperature effect on exhaust, *Low temperature, *Fuel combustion, *Natural gas, *Spark ignition engines, *Exhaust emission control, *Exhaust emission sampling, *Exhaust gases, *Air fuel ratio, *Compression ratio, *Exhaust densities,

*Fuel mixture temperature, *Lean fuel mixtures, *Cylinder pressure, *Unburned hydrocarbons, *Coldstarts, *Intake systems, *Chemical analysis, *Ignition temperature, *Single cylinder engines,

Operating characteristics including ignition limits, cyclic variability, and exhaust emissions were studied in the combustion of natural gas in a spark ignition, single-cylinder, variable compression ratio engine, operated at intake mixture temperatures ranging between 120 degrees and -60 degrees F. The feasibility of using natural gas in a spark ignition engine operated under extremely cold intake temperature conditions was confirmed. Both the maximum peak cylinder pressures and the mass of mixture inducted by the engine increased as the intake mixture temperature was lowered, and the emissions of pollutants were not not significantly increased.

HS-012 843

5K. Maintenance And Repairs

VEHICLE WHOLE LIFE COST PREDICTION--A PURCHASE STRATEGY

For primary bibliographic entry see Fld. 4C.

HS-012 800

DE LA DIMINUTION DE LA CONSISTANCE ET DE LA FREQUENCE DES OPERATIONS D'ENTRETIEN DES AUTOBUS REDUCING THE EXTENT AND FREQUENCY OF MAINTENANCE OPERATIONS ON BUSES)

Y. Savary Paper-6/2

Text in French.

See serial citation

*Bus maintenance, *Bus inspection, *Paris (France), *Preventive maintenance, *Service needs, *Time factors, *Vehicle operating costs, *Fleet management,

The optimum interval between successive maintenance operations on buses with the aim of reducing the total operating expenses of a bus fleet is discussed. Two methods used by the Paris public transport system are outlined: one is based on experience and test results and applied to garage operations (draining the sump, inspection, and adjustments) and safety factors; the other is based on reliability studies and involves modification and replacement of components and units. The results and limitations of the methods are discussed, and the iterative character of the progression towards maximum spacing of maintenance operations is emphasized.

HS-012 801

AUTOMOBILE RELIABILITY--A KEY TO LOWER OVERALL TRANSPORT COSTS

For primary bibliographic entry see Fld. 5D.

HS-012 803

HOW ACCIDENT REPAIR COSTS ARE INFLUENCED BY DESIGN

V. D. Gibbs Paper-6/5

See serial citation

Group 5K—Maintenance And Repairs

*Automobile repair costs, *Automobile repair after accidents, *Automobile design, *Parts costs, *Repairing, *Vehicle marketing,

Comparative repair statistics indicate that repair costs are affected by original automobile design. Modern car design trends are making panel replacement, straightening, panel beating, and painting more difficult, increasing labor time, thus increasing labor costs. The influence of sheet metal part prices on repair costs is also discussed. The study indicates that the cost variation for sheet metal of a new car per pound is 31% while the variation is 72% for replacement parts. If accident damaged parts could be purchased at new car prices, repair costs would decrease considerably. Vehicle design suggestions to reduce vehicle damage and repair costs are included.

HS-012 804

**THE AMERICAN TRUCKING ASSOCIATION:
VEHICLE MAINTENANCE REPORTING STANDARD—
AN INDUSTRY BREAK-THROUGH**

J. C. Paterson Paper-6/6

See serial citation

*Maintenance reports, *Fleet management, *Maintenance costs, *Truck maintenance, *Standardization, *Coding systems, *Preventive maintenance, *Repairing, *Repair costs, *Vehicle mileage, *Economic analysis, *Parts costs,

The American Trucking Association-developed maintenance reporting system designed for use by fleet users and vehicle and component manufacturers, is flexible and provides uniform definitions and methods of reporting as well as a common nomenclature language. Samples of the Vehicle Master Record and Repair Order are included and the information they are capable of providing is analyzed. Vehicle maintenance cost trend and frequency trend analyses and a maintenance history summary are included. Average repair costs per mile are broken down by vehicle component and repair frequency.

HS-012 805

**ROLE OF ANALYSIS IN COMMERCIAL VEHICLE
MAINTENANCE**

J. G. Bisiker R. Goodfellow Paper-6/8

See serial citation

*Truck maintenance, *Fleet management, *Preventive maintenance, *Benefit cost analysis, *Maintenance costs, *Repair costs, *Terminals, *Maintenance reports, *Truck defects, *Test equipment, *Tank trucks, *Great Britain, *Vehicle inspection,

Maintenance problems of a commercial fleet specializing in the bulk distribution of petroleum products are examined. Changes that have taken place in road tanker design, driver productivity schemes, and maintenance requirements caused by these and the introduction of annual vehicle inspection in Great Britain are outlined. To produce optimum maintenance standards with maximum vehicle availability requires an analytical approach for maximum cost effectiveness. Data from a computer based Vehicle Fleet Master File, developed to provide comprehensive cost data and management information for fleet operation, were analyzed to derive planned preventive maintenance systems for three fleet terminals. Under these maintenance systems the mechanical standard of the fleet has been considerably higher

and down time has been reduced by 15%. With continual analysis of results the optimum cost levels will be achieved with a saving of 12% in valeting costs and a possible 10% in maintenance and repair costs.

HS-012 807

**MAINTENANCE AND REPAIR OF MILITARY
VEHICLES**

W. D. H. Blackman Paper-6/9

See serial citation

*Vehicle maintenance, *Military vehicles, *Fleet management, *Repairing, *Reliability, *Maintainability, *Time factors, *Vehicle design, *Preventive maintenance, *Mechanics (personnel), *Repair equipment, *Mathematical models,

The organization of Army vehicle repair is described briefly. The adopted policy of carrying out repairs as far ahead as possible leads to the greatest flexibility. While a formal definition of reliability is practicable, a similar definition of maintainability presents practical difficulties. The Army solution of using Maintenance Advisory Groups to work alongside the designers is suggested as the best solution to the problem.

HS-012 808

DRIVETRAIN PROBLEMS--DO THEY EXIST?

Fleet Facts, Inc.

For primary bibliographic entry see Fld. 5T.

HS-012 823

5L. Manufacturers, Distributors, And Dealers

**ONE MOTOR OIL TO MEET ALL EUROPEAN CAR
MAKERS' REQUIREMENTS--DREAM OR REALITY?**

For primary bibliographic entry see Fld. 5D.

HS-012 798

5N. Occupant Protection

COMPULSORY WEARING OF SEAT BELTS

P. N. Joubert Paper-3/2

See serial citation

*Seat belt usage laws, *Seat belt usage, *Victoria (Australia), *Seat belt effectiveness, *Injury rates, *Injury prevention, *Fatality prevention, *Headgear laws,

In January, 1971, the wearing of seat belts by motorists was made compulsory in the State of Victoria. On the average, 48% of all front seat occupants and 72% of those in cars with belts were found to be using them. During 1971, the number of spinal, facial, and chest injuries decreased, and 64.3% of road crash victims wearing seat belts were injured against 75.6% of those not wearing belts. The overall number of killed and injured in road accidents was reduced by 12% over the mean of 1969 and 1970. It is suggested that seat belts were responsible for this improvement. Comparison is made between seat belt usage requirements and motorcycle rider helmet usage requirements.

HS-012 775

July 17, 1973

VEHICLE SAFETY—Field 5

Propulsion Systems—Group 50

EINFLUSS DER KONSTRUKTION VON PERSONENKRAFTWAGEN AUF VERLETZUNG DER INSASSEN BEIM VERKEHRSUNFALL (INFLUENCE OF THE DESIGN OF PRIVATE CARS ON INJURY TO THE OCCUPANTS IN ROAD ACCIDENTS)

For primary bibliographic entry see Fld. 1B.
HS-012 777

ANALYSES MEDICALES ET TECHNIQUES DES COLLISIONS SUR AUTOROUTE BILAN DE DEUX ANNEES D'INVESTIGATION (MEDICAL AND TECHNICAL ANALYSES OF MOTORWAY COLLISIONS: SURVEY OF TWO YEARS OF INVESTIGATION)

For primary bibliographic entry see Fld. 1C.
HS-012 778

AIRBAG EFFECTIVENESS--A CASE FOR THE COMPULSORY USE OF SEAT BELTS

G. M. MacKay Paper-3/10
See serial citation

*Accident studies, *Restraint system effectiveness, *Air bag restraint systems, *Three point restraint systems, *Injury prevention, *Injury severity, *Injuries, *Fatalities, *Three point restraint system usage, *Accident types, *Injuries by body area, *British vehicles, *Front seat passengers, *Drivers,

Accidents involving current model British cars in which the unrestrained front seat occupants had suffered serious or fatal injuries were studied. The effects that an air bag and a lap and diagonal seat belt would have had on each of the injuries to each passenger were assessed according to specified criteria. Application of the restraint effectiveness criteria to the 133 vehicle sample indicated that, at almost every level of severity of head/face and chest injuries, seat belts are more effective than air bags in preventing injury. Both restraint systems show decreasing effectiveness with increasing injury severity, because of gross passenger compartment intrusion. It was concluded that 34% of front seat occupants would have had their overall injury severity rating reduced if air bags had been installed and 44% if seat belts had been worn. To obtain benefits from seat belts equal to those of air bags requires a 78% belt wear rate.

HS-012 783

HYDRA-FLEX SEAT: A NEW KIND OF RIDE FOR TRUCK DRIVERS

Seats, Inc.
J. Carter SAE-720914
Presented at National Commercial Vehicle Engineering and Operations Meeting, Fort Wayne, 9-12 Oct 1972.
SAE

*Truck seats, *Seat design, *Vehicle riding qualities, *Vibration protection, *Suspension systems, *Truck drivers, *Human factors engineering, *Driver vehicle interface, *Shock absorbers, *Seat height, *Seat cushions, *Seat belts, *Seat belt assembly anchorages, *Seat standards, *Occupant kinematics, *Suspension system spring rates, *Vibration, *Pitch, *Damping, *Hydra Flex Seat,

A review of the highway truck ride problem and conventional solutions emphasizes an increased usage of suspension seats to isolate the driver from cab vibration. The Hydra-Flex seat features an articulated linkage which conforms to similar kinematics as natural motion of the human body and compensates for foot control, steering wheel clearance, seat cushion push-up and rake angle, and seat bottoming problems. This linkage provides an action which cancels the characteristic back-slapping motion of truck cabs. Seat belts may be attached directly to the floor since the Hydra-Flex seat cushion has no vertical motion at its front edge and there is less vertical motion of the rider's legs at the seat buckle position.

HS-012 821

50. Propulsion Systems

FUEL CELL-BATTERY HYBRID VEHICLES

K. R. Williams M. R. Andrew Paper-4/7
See serial citation

*Hybrid vehicles, *Vehicle design, *Hydrazine air fuel cells, *Electric vehicles, *Lead acid batteries, *Secondary batteries, *Vehicle performance, *Weight to power ratio,

A fuel-cell/lead acid battery hybrid vehicle was built to provide practical experience of the engineering problems which would be met with such a power source. In a hybrid power source of this type the mean power requirement of the vehicle is provided by fuel cells. During acceleration and hill climbing when larger amounts of power are required, the output of the fuel cell is supplemented by a secondary battery. This battery is recharged when the vehicle is cruising or at rest. The experience obtained in designing and operating the vehicle is described. Hydrazine air batteries were chosen to power the vehicle in order to provide a liquid fuelled vehicle with a reasonable power-to-weight ratio. A description is provided of the control systems which are necessary to make driving of the vehicle as simple as that of a normal car.

HS-012 794

PROJECT FOR AN ELECTRIC CITY BUS WITH THERMAL REGENERATION

G. Brusaglino Paper-4/9
See serial citation

*Electric buses, *Hybrid buses, *Battery charging, *Regenerative braking, *Electric power generation, *Battery weight, *Vehicle performance, *Propulsion systems, *Nickel cadmium batteries, *Bus design, *Urban transportation, *Equations,

Development of an electric bus with hybrid battery and generator supply has been proposed to reduce air pollution and noise in urban areas. Batteries are recharged by the generator, during the vehicle's run, and from the mains by means of a charger when the vehicle is standing idle. Mains charging is done partially during short terminus stops and totally during longer periods in the depot. Functional relations are established between variables, i.e., route parameters and vehicle plant characteristics, on the basis of which components are designed. The economics of the project are discussed.

HS-012 796

Group 5R—Steering Control Systems

5R. Steering Control Systems

RANDOM VEHICLE VIBRATIONS AS EFFECTED BY DRY FRICTION IN WHEEL SUSPENSIONS

VL N3-4

L. IlosvaiB. Szucs

See serial citation

*Random vibration analysis, *Friction, *Computerized simulation, *Simulation models, *Random vibration, *Vibration response, *Suspension systems, *Random vibration tolerances, *Power spectral density, *Tire pavement interface, *Vehicle stability, *Analog computers, *Road conditions, *Wheel contact loads, *Dynamic loads,

A computer model excited by analog signals generated by filters from the wide-band random signal of a digital noise generator, was used to study the effects of frictional force generated in laminated springs on vibration comfort and vehicle stability. It was concluded that the vibration comfort of an unloaded vehicle will decrease due to dry friction occurring in suspension systems, and as a result of the increase in frictional force, the fluctuation of the dynamic wheel load and the danger of the wheel's departure from the ground will increase.

HS-012 812

VEHICLE MOTION ANALYSIS IN RELATION TO VEHICLE SAFETY

VL N3-4

H. K. Sachs

Prepared for presentation at Illinois Univ., Urbana, 17 May 1972.

See serial citation

*Vehicle handling, *Accident avoidance, *Vehicle performance, *Vehicle stability, *Performance tests, *Simulation models, *Accident investigation, *Mathematical representations, *Steering tests, *Braking, *Lateral acceleration, *Yaw, *Vehicle mass, *Speed, *Vehicle safety,

The influence of vehicle handling on the possible avoidance of accidents is discussed. Accident reconstruction at present does not provide the necessary information to relate accident causes to the lack of road worthiness of vehicles. Vehicle behavior in proximity of its performance limit must be determined in order to infer its accident avoidance potential. A review of the state of the art of vehicle modeling, simulation of vehicle maneuvers, and full scale testing is presented. The application of the direct method of the stability theory is suggested as a possible means of obtaining performance limit envelopes which are necessary for establishing standards of vehicle performance.

HS-012 814

SIMULATION OF TRACTOR-SEMITRAILER HANDLING

Cornell Univ.

A. I. KrauterR. K. Wilson SAE-720922

Presented at National Commercial Vehicle Engineering and Operations Meeting, Fort Wayne, 9-12 Oct 1972.

SAE

*Truck handling, *Tractor semitrailers, *Computerized simulation, *Simulation models, *Vehicle dynamics, *Tire forces, *Driver simulation research, *Braking, *Turning radius, *Brake

torque, *Tire slip motion, *Tire loads, *Tire pavement interface, *Coefficient of friction, *Truck performance, *Wet road conditions, *Braking distance, *Fifth wheel devices, *Braking forces, *Truck stability, *Yaw, *Wheel locking, *Jackknifing, *Pitch, *Roll, *Weight transfer, *Speed, *Axle brakes,

A computer model of a tractor semitrailer is developed which allows translation, yaw, roll, and pitch of both tractor and semitrailer. Lateral and fore-and-aft weight transfer is displayed. Wheel dynamics are included, and effects of wheel slip, slip angle, vehicle speed, and tire load are used in the calculation of the tire forces. The vehicle is maneuvered by a simulated driver who specifies the front-wheel steer angle and the brake torques. The ability of the model to accurately describe a real vehicle is studied by using the model to simulate a full-scale experimental test. The model is also used to study two types of proportional braking for a tractor-semitrailer executing a large-radius turn on a wet asphalt track.

HS-012 818

DUAL-USE FLUIDS FOR POWER STEERING AND POWER BRAKES

Dow Corning Corp.

B. C. Brenner SAE-720912

Presented at National Commercial Vehicle Engineering and Operations Meeting, Fort Wayne, 9-12 Oct 1972.

SAE

*Fluids, *Power steering systems, *Power brakes, *Silicones, *Lubricants, *Wear resistance, *Viscosity, *Temperature, *Thermodynamic properties, *Compression, *Foaming, *Miscibility, *Flammability, *Dielectric properties, *Toxicity, *Costs, *Corrosion tests, *Corrosion prevention, *Elastomers,

Increasing underhood temperatures and decreasing availability of vacuum, indirectly caused by more stringent safety and emission control regulations, brings the possibility of central hydraulic systems closer. As the central system fully evolves, a transition step is expected where the same fluid will be used in both the power steering and power braking systems. With the expected demands on fluids to be used in such systems increasing, a silicone candidate, based on the most readily available silicone fluid, dimethylpolysiloxane is being developed. Recent advances in lubrication technology, information on compatibility with presently used materials, and the physical and chemical properties, including viscosity-temperature characteristics, volatility, shear stability, thermodynamic properties, compressibility, foaming, demulsibility, rust prevention, gas solubility, fire resistance, dielectric properties, and toxicity, which allow a silicone fluid to be a candidate for such usage, are presented. Environmental effects, availability, and price of silicone fluid components are discussed.

HS-012 822

THE TRUCK STEERING SYSTEM FROM HAND WHEEL TO ROAD WHEEL

Ford Motor Co.

J. W. Durstine SAE-730039; SAE-SP-3

Presented at the 19th L. Ray Buckendale Lecture.

SAE

*Steering system design, *Truck design, *Truck handling, *Steering wheels, *Steering columns, *Steering gear, *Steering gear ratios, *Roads, *Truck cabs, *Front suspension systems,

*Vehicle dynamics, *Cornering, *Lateral acceleration, *Shimmy, *Axle tramp, *Front axles, *Crosswind, *Linkages, *Control arms, *Loading (mechanical), *Power steering pumps, *Reservoirs, *Steering system failures, *Mathematical representations, *Valves, *Pressure, *Tire characteristics, *Torque, *Ball joints, *Tire rod ends, *Cams, *Cylinders, *Power steering systems, *Steering systems,

Commercial vehicle manual and power steering system design and development is covered from the total vehicle viewpoint. The effects of the cab package, front suspension, wheel offset, and tires on a manual steering system, and the relationship of axle tramp and shimmy, crosswinds, and lateral acceleration changes in a curve to steering system performance are described. Manual steering system characteristics, including linkage ratios, reversibility, efficiency, and effort are outlined, and manual steering system loads are evaluated. A description of power steering system components and characteristics, including pump and reservoir, control valves, power cylinders, semi-integral systems, integral gear, and loading is presented. Power steering system design and reliability are outlined, and a prototype of a power steering system is evaluated.
HS-012 830

HANDLING CHARACTERISTICS OF THE GENERAL MOTORS EXPERIMENTAL SAFETY VEHICLE

General Motors Corp.
B. J. Finn P. M. Riede A. E. Roller SAE-730079
Presented at International Automotive Engineering Congress, Detroit, 8-12 Jan 1973.
SAE

*Experimental automobiles, *Safety cars, *Vehicle handling, *Chassis design, *Simulation, *Performance tests, *Front suspension systems, *Rear suspension systems, *Automatic level control, *Leveling devices, *Steering system design, *Instrumented vehicles, *Yaw, *Lateral acceleration, *Steady state, *Vehicle stability, *Wet road conditions, *Dry road conditions, *Tire inflation pressure, *Vehicle control, *Test tracks, *Turning radius, *Steering, *Tire characteristics,

The Experimental Safety Vehicle chassis was designed to meet or exceed specifications relating to accident avoidance, commensurate with subjectively good handling. A linear vehicle directional control simulation was employed to determine design direction. A tire analysis program was the basis for reference tire characteristics emphasizing force and moment performance. A preliminary suspension design layout was prepared and a pretest car was constructed. Development of this vehicle generated suspension information for the final design. An acceptable tire construction was specified for the prototype vehicles. The suspension, steering, and level control systems are described. Tests on a fully instrumented prototype indicated compliance with all specifications except low speed (25 mph) returnability. In actual driving, however, the returnability at all speeds was subjectively rated acceptable.
HS-012 839

5T. Trucks And Trailers

DEVELOPMENT OF A POWER PLANT PROGRAM FOR COMMERCIAL AND PUBLIC TRANSPORT VEHICLES

For primary bibliographic entry see Fld. 5D.
HS-012 791

ROLE OF ANALYSIS IN COMMERCIAL VEHICLE MAINTENANCE

For primary bibliographic entry see Fld. 5K.
HS-012 807

SOME OF THE PROBLEMS RELATED TO THE DESIGN OF PRIMITIVE LEVERED VEHICLES

VL N3-4
W. H. Bussell Z. U. Rahman D. M. Moore H. T. Taylor
Prepared at Auburn Univ. under Cooperative Agreement No. 12-11-008-808 Supp. 14 with the Forest Service, Southern Forest Experiment Station.
See serial citation

*Vehicle design, *Levers, *Vehicle control, *Multiple lever control, *Off the road vehicles, *Actuators, *Vehicle stability, *Control location, *Computerized simulation, *Automatic control, *Manual control,

Stable modes of operations, which are developed from a knowledge of the requirements of levered locomotion in machines, must be achieved before the successful operation of such a levered vehicle is achieved. Problems include development of an adequate lever system, an actuation system, and a control system which regulates the foot placement and the motion pattern of each lever. The machine must be capable of maneuvering, of adjustment to terrain irregularities, and of recovery from gross motion disturbances. Levered vehicles are classified into automatic and operator monitored machines, the latter being those with complete operator control of all lever motions. Problems include lever design, foot locus, actuation systems, and lever arrangements. Some designs are considered with respect to two specific types of lever arrangements. A design approach utilizing a visual simulation technique operated with the help of a graphic computer terminal is suggested.
HS-012 813

SIMULATION OF TRACTOR-SEMITRAILER HANDLING

Cornell Univ.
For primary bibliographic entry see Fld. 5R.
HS-012 818

POWER/WEIGHT RATIO FOR TRACTOR TRAILERS

Associated Truck Lines, Inc.
D. L. Paul SAE-720916
Presented at National Commercial Vehicle Engineering and Operations Meeting, Fort Wayne, 9-12 Oct 1972.
SAE

*Tractor trailers, *Weight to power ratio, *Truck performance, *Computerized simulation, *Truck power, *Vehicle weight, *Engine performance, *Speed, *Engine size, *Power output, *Horsepower, *Routes, *Road grades, *Road tests, *Performance tests,

The use of a computer-generated vehicle mission simulator has made it possible for truck operators and manufacturers to select a horsepower-to-weight ratio to fulfill the requirements for operation over a known terrain. Actual road speed is compared with computer simulated speed of vehicles of varying weights and engine power at check points on selected test routes. Results indicate that the value of increased horsepower is overestimated in attaining greater performance returns.
HS-012 819

Field 5—VEHICLE SAFETY

HSL 73, No. 13

Group 5T—Trucks And Trailers

HYDRA-FLEX SEAT: A NEW KIND OF RIDE FOR TRUCK DRIVERS

Seats, Inc.
For primary bibliographic entry see Fld. 5N.
HS-012 821

DRIVETRAIN PROBLEMS--DO THEY EXIST?

Fleet Facts, Inc.
J. E. Paquette SAE-720911
Presented at National Commercial Vehicle Engineering and Operations Meeting, Fort Wayne, 9-12 Oct 1972.
SAE

*Drivetrains, *Fleets, *Vehicle maintenance, *Fleet management, *Repairing, *Repair costs, *Maintenance costs, *Vehicle mileage, *Power takeoff equipment,

Drivetrain operating systems are described, and the maintenance and repair history of 1,472 vehicles randomly selected from 14 fleets, covering 30,408,000 miles from September through December 1971 is reviewed in tabular form. Analysis of data for line-haul vehicles indicates that while approximately 7% of the repair orders concerned the drivetrain, almost 13% of the total dollars was consumed by repairs in this category. Almost 16% of the parts dollars was consumed by drivetrain repairs, as compared with approximately 10% of the labor dollars. There was a higher overall drivetrain cost per mile for pickup and delivery vehicles as compared to line-haul vehicles due to the nature of the stop and go pickup and delivery operation. Although fewer repair orders were submitted on the pickup and delivery units, they represent a larger percentage of total input for their particular application.

HS-012 823

OSHKOSH POWERMATIC TRANSMISSIONS FOR ON/OFF-HIGHWAY VEHICLES 04W. K. Blank

Oshkosh Truck Corp.
For primary bibliographic entry see Fld. 5D.
HS-012 824

A SHIFTABLE CONTROLLED TRACTION DIFFERENTIAL FOR HEAVY-DUTY TRUCKS

Eaton Corp.
For primary bibliographic entry see Fld. 5D.
HS-012 826

4 X 4 HIGHWAY TRACTOR CONCEPTS

Eaton Corp.
For primary bibliographic entry see Fld. 5D.
HS-012 829

THE TRUCK STEERING SYSTEM FROM HAND WHEEL TO ROAD WHEEL

Ford Motor Co.
For primary bibliographic entry see Fld. 5R.
HS-012 830

5V. Wheel Systems

HYBRID SIMULATION OF SHEAR FORCE DEVELOPMENT OF A TIRE EXPERIENCING LONGITUDINAL AND LATERAL SLIP

H. B. Pacejka P. S. Fancher Paper-3/12
Sponsored by Automobile Manufacturers Assoc.

See serial citation

*Tire slip motion, *Mathematical models, *Pneumatic tires, *Computerized simulation, *Tire road contact forces, *Shear modulus, *Coefficient of friction, *Lateral force, *Hybrid computers, *Equations of motion, *Tire pavement interface, *Longitudinal force, *Tire forces, *Tire properties,

A model of the pneumatic tire is developed to explain the production of shear force under different operating conditions and to serve as a mathematical representation of the tire in computer simulations of vehicle performance. Brush-type (rigid carcass with row of elastic tread elements) and flexible-carcass-type models are considered. For analytic purposes, the carcass is represented by a structure whose elastic properties are defined by an experimentally obtained influence function. The calculations are performed on an AD-4 hybrid computer. Simplified computer block diagrams are presented, and some typical results are discussed.

HS-012 785

A DYNAMICAL ANALYSIS OF A TOWED TWO-WHEEL TRAILER

VL N3-4
E. A. Saibel S. Chiang
Presented at International Conference on Vehicle Mechanics (2nd), Paris, 6-9 Sep 1971. Work was performed under a National Bureau of Standards contract.
See serial citation

*Pavement friction, *Tire skid resistance, *Trailers, *Mathematical models, *Coefficient of friction, *Equations of motion, *Suspension systems, *Tire loads, *Vehicle dynamics, *Roll, *Pitch, *Wheel locking friction, *Damping, *Stopping time, *Vehicle center of gravity, *Wheelbases, *Tire forces, *Tire inflation pressure,

The towed trailer method for skid resistance measurements is a practical one for characterizing friction characteristics of highway pavements, and has been standardized by the American Society for Testing Materials (ASTM). A mathematical model of the trailer which includes roll, pitch, and vertical motion is presented. The skid resistance calculated by using this model gives an excellent check on the standard ASTM skid number formula. The response time and damping effect after locking one test wheel can be clearly seen in this model. Possible effects of the dimensions of trailer, stiffness of suspension system, and tire pressure to skid resistance can also be examined.

HS-012 811

RANDOM VEHICLE VIBRATIONS AS EFFECTED BY DRY FRICTION IN WHEEL SUSPENSIONS

For primary bibliographic entry see Fld. 5R.
HS-012 812

NOSPIN AND TANDEM-LOCK DIFFERENTIALS--OPERATION AND APPLICATION

Detroit Automotive Products Corp.
For primary bibliographic entry see Fld. 5D.
HS-012 827

FEASIBILITY STUDY OF TRAILER TECHNIQUES FOR TIRE TRACTION, VOL. 1: SUMMARY. FINAL REPORT

Goodyear Tire and Rubber Co.

July 17, 1973

VEHICLE SAFETY—Field 5

Wheel Systems—Group 5V

A. F. Ramsey J. D. Eagleburger S. R. Sacia
Report for Apr 1972-Jan 1973. evaluate the effect of tire load,
tire inflation pressure,
NTIS

*Tire traction, *Trailers, *Tire tests, *Braking forces, *Skid resistance tests, *Tire test equipment, *Coefficient of friction, *Tire loads, *Tire inflation pressure, *Speed, *Water depth, *Wet road conditions, *Data analysis, *Statistical analysis, *Tire pavement interface, *Tire skid resistance, *Tire slip motion, *Tire performance, *Feasibility studies, *Test reproducibility,

A nine-month test utilizing a two-wheeled towed traction trailer

was conducted to evaluate existing methodology for determining the relative braking traction characteristics of a production test tire and an American Society for Testing Materials tire. The test was designed to determine the repeatability of the test procedure and apparatus and to evaluate the effect of tire load, tire inflation pressure, road speed, road surface coefficient of friction, and surface water depth. Statistical techniques are employed to analyze the data with respect to the test reliability. The influence of the varied test parameters is demonstrated by the data tabulations and graphs. Specific details of the apparatus and technique are examined with regard to refining the two-wheeled trailer traction measurement.

HS-800 811

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